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Hygiene.

BY ALFRED CARPENTER, M.D., M.R.C.P. (LOND.).

HOW TO PREVENT DISEASE IN SCHOOL AND HOME (*continued.*)

Asiatic Cholera (continued).—The bacillus of Koch has, however, been detected in places, and under conditions which show that it does not always produce cholera, and cases have been seen of that disease in which the comma bacillus has not been found, so that there are eminent men who continue to assert that the connection between the comma bacillus and the disease is not only not proven, but is absolutely discredited. I am not able to solve this point, but I am clearly of opinion that cholera is associated with an organism in some shape or form, and that without the organism the disease will not appear, though we may have failed to detect it at the time at which it has been looked for. We are able to prove by analogy that similar diseases are produced by such causes, and no other. There is a complaint to which fowls are liable, called chicken cholera, which has been produced by something. The blood of chickens dying of the disease has been examined, and a peculiar microbe found which has been cultivated in gelatine. If some portions of the new growths are inserted into healthy fowls, a similar disease is induced which is rapidly fatal. Organisms of a like character are then found in all the organs of the body of the new case, and in the intestinal discharges if they are looked for immediately after death. Mr. Crookshank, who has examined most carefully into this matter, says: 'If the fowl be inoculated with some of these organisms which have been kept for some time, local changes only are produced, and the fowl is protected from the action of a more virulent culture at a subsequent period, thus affording an example of the mitigation of the virus. The microbe is ærobic (that is, cannot live without oxygen), and its toxic effect is said to be due to the abstraction of oxygen from the blood, producing asphyxia.' (Crookshank's Bacteriology, page 125.)

This is a most important fact which bears upon the causation of the disease, at the same time pointing out a possible means for mitigation when it is impossible to prevent the immediate multiplication of the disease itself; but sanitarians will not be satisfied with mitigation; they insist upon the possibility of prevention. We may be certain that cholera is in no sense contagious in the way that scarlatina or small-pox is contagious; its infectiveness is connected with local and personal conditions. If those conditions which favour it are allowed to continue, it may develop with terrific force. It is the discharges from the stomach and bowels which are especially infective. Cases will propagate from one to another by those means, provided some of the infective matter is conveyed by food or water into the alimentary canal of another person. If a case of cholera be imported into a place there will be no probability of spreading the disease if all the discharges of every kind are at once destroyed; none should be allowed to go into any drain, sewer, cesspool, or earth closet, but be at once destroyed either by heat or by chemical means. Any bedding which has been soiled by choleraic discharges, or any clothing or towels which may have been infected, should be boiled for some time. The water in which the patient washes should be treated with sulphate of iron, so that it shall not be possible for either sub-soil or drinking water to be infected thereby. If any ditches or other depôts of stagnant water or filth of any kind have been possibly infected, they should be perfectly cleansed by large quantities of solution of sulphate of iron, and if possible the muddy matter should be burnt up with ashes and earth, so that no water supplies shall be contaminated by soakage from such ditches. Any district which is cholera laden may produce a miasmatic atmosphere which may assist to spread the disease, if cholera is epidemic in that district. Those who have been living in such a district may have been poisoned by the cholera germ. They may remove from that district and travel long distances and remain for several days apparently perfectly well, and then fall ill with slight choleraic diarrhœa, keeping all the time at their duties, or being engaged in business; they spread the mischief without being absolutely aware of the fact. It is these ambulatory cases which introduce mischief into new districts. There is no

absolute way to prevent this result except by taking away the possibility of the imported germs being cultivated in favouring sites, and breeding a more virulent form of disease. It is most important, therefore, for local authorities to be prepared, 1st, by not allowing the breeding plots to exist, and 2nd, obtaining the most immediate information as to the introduction of a case from an infected district, so that the imported fire may be put out before disease is set up broadcast. Security may be obtained by combined action.

1st, by local authority as to purity of water supply. By continuous cleansing of all situations in which house refuse is stored, all sinks, and house drains should be frequently washed down with disinfectants, and all back premises should be lime whitened.

2nd. The local authority should supply whitewash gratis, and lend out brushes, so that our poor should be able, at the cost of labour only, to protect themselves. The cost of whitewash and brushes would be very small compared with the good health which would be thus introduced into the homes of the poor, independently even of the obstruction to cholera manufacture. If the local authority would also distribute handbills with directions as to the procedure in lime whiting, and times and places of application for whitewash and brushes, much good would be done and valuable time saved.

Then 3rdly, there is the duty of the individual to himself and his family to discover the disease at the earliest possible moment, for the greater the dose and the longer the micro-organism is allowed to go on increasing in a man's blood, the greater the danger to his life. A continuous diarrhœa with rice water like evacuations without much pain, are suspicious circumstances, and when present, especially if cholera be rampant anywhere in the country, medical advice should be at once sought for. If the person has come from an infected district, he should go into quarantine at once, and stay there until certified as cured by the local M.O.H., to whom he should report himself the moment the nature of the case is suspected.

Dysentery.—This is a disease peculiar to tropical climes, but once upon a time it was very common in this country. It has been the scourge of British armies from the earliest date of a standing army until the present time. It is now rarely seen as a cause of death in the British Isles, and the spread of sanitary knowledge among army and navy surgeons is gradually banishing it from the British settlements in other parts of the world. Chronic cases which have been contracted in the Colonies are not unusual at home: the disease has not been fatal, but its sequences hang upon the patient sometimes for years. It is especially a specific disease, and being brought into the country can, and does occasionally, spread among the people. There is an eruption something similar to that of typhoid fever, but it occupies the mucous membrane of the lower bowel. The membrane is denuded, and it becomes ulcerated. The eruption occurs about the 18th or 20th day of the disease, and if not cured it may lapse into the chronic form and continue for months and even years. It begins with diarrhœa, then fever; there are shreds of mucous membrane in the discharges, intense pain with bloody stools, which are also excessively offensive. The stage of incubation may be very short, so that those visiting an infected district may suffer almost immediately. It is contagious, it may be propagated by any of the human excretions, and, unlike typhoid, is undoubtedly capable of being easily propagated by aerial means. Those inhabiting or visiting marshy districts being sometimes rapidly affected. The soil contains its active principle. The drinking water is often the means by which it enters the body. It may cling to the clothes or be conveyed in the air. It is closely allied to cholera, differing from the latter disease in its more marked connection with miasmatic influences. It is a disease which has shown the effect of sanitation at home in the most marked degree, for whereas it used to abound in the lowest parts of London, it has now entirely disappeared from the metropolis since the drainage of all the low-lying districts has been effected, and the consumption of the subsoil water altogether discontinued. Dysentery being removed, the same districts became also less liable to typhoid and cholera. A persistence in personal cleanliness, as well as in telluric action is necessary to get rid of all three diseases.

English Cholera and Diarrhœa abound in some districts because the sanitary conditions of the locality or of the individual are wrong. This class, when epidemic, is intimately associated with the temperature of the subsoil. If the ground air rises above a certain line, and the ground water subsides from evaporation, if the subsoil is soaked with sewage, there will be diarrhœa in that district, especially among the children of the poor; those who live in houses built upon made gravel being especially subject to it. A bacillus has been discovered in all cases which have been scientifically examined, which corresponds with a similar one found in cases of English cholera.

Intermittent Fever.—This is a disease closely allied to dysentery. It is better known as *ague*, *malarial fever*, or *marsh fever*, and like to dysentery is disappearing from the country as the marshy districts become drained and brought into good cultivation. It is always associated with impurity in ground air, and has been traced to a bacillus by Klebs. These grow in liquids which are rich in nitrogen, and especially when forms of ammonia compounds are present, so that they rise and decay in a given district, by reason of chemical changes in the character of the subsoil water. They have been found in the Roman campagna, in marshy districts in America, and in all districts in which ague abounds, so that it is certain that the disease is a manifestation of the growth of micro-organisms in the human blood. It is possible that the hot stage, and its development at intervals of one, two, three, four, or more days, is dependent upon the habit of the germ to mature at longer or shorter intervals, and that the maturation of the germ is coincident with the high fever, whilst the production of a new supply of micro-cocci leads to a fresh ague fit as the new seeds develope and mature into perfect microbes. Ague can be entirely prevented by drainage and the introduction of a pure water supply, but the only means by which the disease can be satisfactorily and certainly treated is by removal from the district in which it has been contracted. When this is not possible, various drugs, such as quinine, arsenic, and other germicides are found to be effectual for a time, but it is better to go away from that district to a higher ground and purer water if health is to be certainly secured.

There is another class of infectious diseases which must not be passed over, as they occasionally infest a district and are not always recognised as to some extent interchangeable.

They are *Erysipelas, Puerperal Fever, and Hospital Gangrene.* Besides these there are the class of diseases now distinctly associated with maladies which affect animals, and which are recognised as capable of transmission in various forms to human beings. They are *malignant pustule* or *charbon, anthrax* or *carbuncle, eczema epizootica* or *foot and mouth disease, glanders, farcy, rabies,* and *hydrophobia.* They form a class which is most interesting to the pathologist and the sanitarian, as showing intimate association with animal life which has been suspected for a long time, but which has only recently been proved to exist.

Erysipelas is undoubtedly propagated by a micro-organism, which possibly varies in its character according to its origin. Closely associated with the fermentations which accompany decomposition of animal discharges and remains, some kinds always appearing when butyric acid fermentations take place. They set up disease in the human body if it be prepared for their reception by impurity in the blood of the recipient. One or more forms of these produce erysipelas or diffuse cellular inflammation, or pyœmia, or endocarditis (a disease of lining membrane in the heart), according to the combinations which may be brought about by contact. One state of the blood determining one kind, as the so-called rheumatic inflammation (or acute ædema or some other affection of cellular mischief) another, erysipelas on the surface of the skin itself.

Whenever *Erysipelas* appears in the list of diseases which are affecting the district, it behoves the local authority to be on the alert, for one case may make many. The household in which it is found must be as careful as if typhoid fever had to be dealt with, the excreta and discharges being destroyed as perfectly as possible.

Erysipelas is especially liable to affect those who have flesh wounds, those made as scratches by thorns or pins being even more susceptible of taking on the complaint than clean cuts. If there are numerous cases in a given district at a particular time, it behoves the surgeon to be more careful as to operating in cases which may be safely delayed. All surgical instruments and apparatus of every kind must be exposed to the heat of boiling water, at least, for some time before being used again, and all bandages, lint, or other appliances which may have been infected should be destroyed. It is a disease which is very liable to affect those who addict themselves to the use of intoxicating liquors, or live in the atmosphere of places where such liquors are sold.

Puerperal Fever.—There is some kind of connection between this disease and erysipelas which is not at present quite made out. There may be also a link between it and some forms of scarlatina, especially that form which is sometimes called *surgical scarlatina,* and which is probably associated with the decomposition of impure blood. It ought to be a law that no medical man should be called upon to perform any *post-mortem* or be in attendance upon cases of erysipelas or scarlatina, if he is at the same time liable to be summoned to assist a female in confinement. Medical Officers of Health also should not be engaged in the department of midwifery, because they may be called upon to come into personal contact with infectious materials capable of setting up the disease in question, and it is quite impossible for the surgeon to be sure of having destroyed the germ of mischief which may be under his finger nails or on the cuff of his coat. Midwifery should either be relegated to women or obstetric doctors should be prohibited from engaging in *post-mortem* operations or from becoming Medical Officers of Health.

Glanders and *Farcy* may be conveyed by direct inoculation from animal to man, it is only necessary to mention the possibility, and to advocate the most careful cleanliness to those who are engaged among animals.

Rabies and *Hydrophobia.*—It would not be right to close this chapter without a reference to these diseases. Rabies in the dog becomes hydrophobia in man, but whilst the affected dog rushes to, and drinks water with avidity, the man is convulsed by the sight or sound of the liquid. The human disease always arises by direct inoculation from the mad dog or cat or other domestic animal. The virus is in the saliva, having been inserted beneath the skin it produces its ultimate result if at all, within about four months.

(To be continued.)

—o—

Easy Steps in Trigonometry.

BY REV. A. D. CAPEL, M.A.,

Author of 'Catch Questions in Arithmetic,' etc., etc.

ANSWERS AND HINTS TO SOLUTIONS.

CHAPTER XIII.

1. $\text{Log } \cdot 002 = \bar{3}\cdot 30103$
$\log (\cdot 002)^{\frac{1}{4}} = \frac{1}{4}$ of $\bar{3}\cdot 30103$
$= \bar{1}\cdot 3252075.$

2. $16 = 2^4 = 8^{\frac{4}{3}}$
$\therefore \frac{4}{3} = \log_8 16$

3. $\text{Log } 2 = \cdot 30103$
$\log 2^{24} = 24 \times \cdot 30103$
$= 7\cdot 22472$
$\therefore$ there are 8 figures in 2^{24}
or the number is between 10 millions and 100 millions.

4. $\text{Log } 2 = \frac{1}{3} \log 8$
$\log 3 = \frac{1}{2} \log 9$
$\log 6 = \log 2 + \log 3 = \frac{1}{3} \log 8 + \frac{1}{2} \log 9$

5. $5 = \frac{10}{2}$
$\log 5 = 1 - \log 2$
$\log 125 = 3 \log 5$
$= 3 (1 - \log 2)$
$\cdot 00125 = \log 125 - 5$
$\therefore \log \cdot 00125 = 3 (1 - \log 2) - 5$
$= -2 - 3 \log 2$
$= \bar{2} - \cdot 90309$
$= \bar{3}\cdot 09691.$

6. $225 = 9 \times 25$
$= 3^2 \times 5^2$
$= 3^2 \times (\frac{10}{2})^2$
$\therefore \log 225 = 2 \log 3 + 2 (1 - \log 2)$
$\therefore$ you require logs 2 and 3.

7. Knowing A and a this belongs to the first case. $C = 180 - A - B = 70$

and $\frac{c}{\sin 70} = \frac{a}{\sin A} = \frac{2}{\sin 60}$

$\log c = L \sin 70 - L \sin 60 + \log 2.$

8. Tan $\frac{A-B}{2} = \frac{11}{21} \cot 10°$

$\therefore L \tan \frac{A-B}{2} = \log 6 - \log 19 + L \cot 10$ which would give us $\frac{A-B}{2} = a°$ suppose but $\frac{A+B}{2} = \frac{180-20}{2} = 80°$

$\therefore A = (a + 80)°.$

9. If a were nearly = b + c, A would be nearly = 180° and $\frac{A}{2}$ nearly = 90° but tan 90° = ∞ ∴ a very slight error in the calculation of the logarithms would make a considerable error in the angle required.

10. Log 12400 = 4·0934217
log 12300 = 4·0899051
diff. = ·0035166
100 : 45 = ·0035166 : x
x = ·0015824
∴ log 12345 = 4·0914875.

11. Difference for 60″ = ·0005242
∴ difference for 37″ = ·0003232
∴ L tan 14° 24′ 37″ = 9·4098444

12. If we know the sine of an angle we know the cosine of its complement. Similarly if we know all the logarithmic cosines from 0° to 45° we know all the logarithmic sines from 45° to 90°, and similarly with the other pairs of ratios.

13. The radius will be a straight line containing 10000000000 or 10^{10} linear units.

14. L cos 28° 35′ = 9·9435549
L cos 28° 36′ = 9·9434861
difference for 60″ = ·0000688
47″ = 60″ − 13″
60 : 13 = ·0000688 : x
difference for 13″ = ·0000149
∴ L cos 28° 35′ 47″ = 9·9435010.

15. If sin 30° = 500000 the radius of the circle to which the sine is referred is 1000000 or 10^6 linear units.

16. Let CAD = 30° and let CA = 40 linear units. With centre C distance 30 linear units describe a circle, this will cut the line AD in two points B and B_1, either of the triangles CAB or CAB_1 will have the angle A = 30°, b = 40, and a = 30.

This is called the ambiguous case; whenever, that is, we have given 2 sides and the angle opposite the less side. To solve the triangle we must know whether B is acute or obtuse.

17. The student is recommended to draw a figure, thus:

Let AC be a horizontal line; from C draw CB perpendicular to AC, join BA. Then BCA is a right angled triangle, right angled at C.

$$a = c \sin A \text{ and } b = c \cos A$$
$$\therefore a + b = c \sin A + c \cos A$$
$$\text{or } c = \frac{(a+b)}{\cos A + \sin A}$$

18. $\frac{a}{b} = \frac{\sin A}{\cos A}$

$\therefore a \cos A = b \sin A$

and $a \cos A + a \sin A = a \sin A + b \sin A.$

$$\therefore a = \frac{(a+b)\sin A}{\sqrt{2}\left(\cos A \frac{1}{\sqrt{2}} + \sin A \frac{1}{\sqrt{2}}\right)}$$
$$= \frac{(a+b)\sin A}{\sqrt{2}\cdot\cos(A-45°)}$$

19. As in 18

$$b \sin A = a \cos A$$
$$\therefore b \sin A - b \cos A = a \cos A - b \cos A$$
$$\therefore b = \frac{(a-b)\cos A}{\sqrt{2}\sin(A-45°)}$$

20. Ans. $c = \frac{(a-b)\sin A}{\sqrt{2}\sin(A-45°)}$

21. We must first prove that in a right angled triangle $\tan \frac{A}{2} = \frac{c-b}{a}$

Let $x = \tan \frac{A}{2}$

$$\therefore \tan A \text{ or } \frac{a}{b} = \frac{2x}{1-x^2}$$
$$\therefore x \text{ or } \tan \frac{A}{2} = \frac{\sqrt{a^2+b^2}-b}{a} \text{ or } \frac{c-b}{a}$$

Since $c^2 - b^2 = a^2$

$(c + b)(c - b) = a^2$

$$\therefore \frac{a}{c+b} = \frac{c-b}{a} = \tan \frac{A}{2}$$
$$1 = \frac{b+c}{a} \cdot \tan \frac{A}{2}$$
$$\text{and } b = (b+c)\frac{b}{a} \cdot \tan \frac{A}{2}$$
$$= (b+c)\cot A \cdot \tan \frac{A}{2}$$

22. Let $x^2 = \sin^2 \frac{A}{2}$, and $1 - x^2 = \cos^2 \frac{A}{2}$

$$\therefore 4x^2(1-x^2) = \sin^2 A = \frac{a^2}{c^2}$$

Solving this quadratic.

$$\therefore x^2 \text{ or } \sin^2 \frac{A}{2} = \frac{c \pm b}{2c}$$
$$c = \frac{2c(c-b)}{2(c-b)} = \frac{c-b}{2.\frac{c-b}{2c}} = \frac{c-b}{2\sin^2 \frac{A}{2}}$$

23. Let $(a + b) = z$.

$$\therefore 2c^2 = 2a^2 + 2b^2$$
$$z^2 = a^2 + 2ab + b^2$$
$$\therefore 2c^2 - z^2 = a^2 - 2ab + b^2$$
$$\therefore \sqrt{2c^2 - z^2} = a - b$$
$$\therefore a = \tfrac{1}{2}[z + \sqrt{2c^2 - z^2}]$$
$$\text{and } b = \tfrac{1}{2}[z - \sqrt{2c^2 - z^2}]$$
$$\therefore \text{area} = \tfrac{1}{2}ab = \tfrac{1}{8}[z^2 - 2c^2 + z^2]$$
$$= \tfrac{1}{4}(z+c)(z-c)$$
$$= \tfrac{1}{4}[(a+b)+c][(a+b)-c]$$

24. Work as in 23.

$$\text{area} = \tfrac{1}{4}(c^2 - z^2)$$
$$= \tfrac{1}{4}[c - (a-b)][c + (a-b)]$$

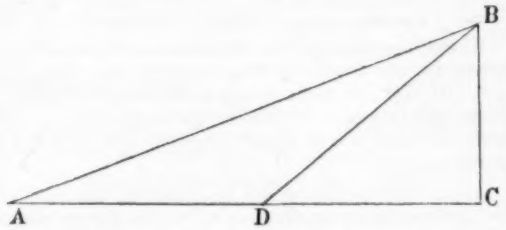
25. $CD^2 = c_a c_b$

$$\tan^2 A = \frac{CD^2}{c_a^2} = \frac{c_a c_b}{c_a^2} = \frac{c_b}{c_a}$$
$$\frac{1-\tan^2 A}{1+\tan^2 A} = \frac{c_a - c_b}{c_a + c_b} = \frac{c_a - c_b}{c}$$
$$\frac{1+\tan^2 A - 1 + \tan^2 A}{1+\tan^2 A + 1 - \tan^2 A} = \frac{c - c_a + c_b}{c + c_a - c_b}$$
$$\therefore \tan A = \sqrt{\frac{c - c_a + c_b}{c + c_a - c_b}}$$

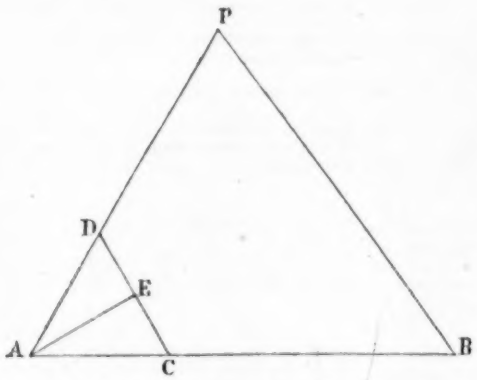
CHAPTER XIV.

MEASUREMENT OF HEIGHTS AND DISTANCES.

195. We now come to the most interesting and practical part of trigonometry.



196. Let A be a point at which an observer's eye is placed and BC an object, *e.g.*, the tower of a church, the height of which he wants to know. Surveyors have instruments by which they can measure the angle BAC called the angle of elevation, if AC be horizontal. Let BA be taken, *i.e.*, measured, and let AC be horizontal, and also let BCA be a right angle. Now we know two, and therefore three, of the angles of the triangle BAC but knowing no side we cannot solve the triangle. In AC let us measure AD, and take with our instrument the angle BDC. Knowing BDC we know BDA so now we are in a position to solve the triangle BDA since we know the three angles and the side AD, hence we can find BA, and so solve the original triangle BAC and find the height of the tower BC.



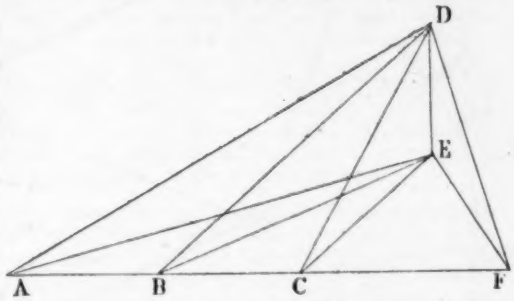
197. Let P be a point on the other side of a river, and let the surveyor be on the same horizontal plane with the object. If he want to find the distance that P is away from him, he finds some other point B and measures AB and then finds the angles PAB and PBA with his surveying instrument. He now can solve the triangle PAB and he therefore knows AP or how far P is from A.

198. Colonel Everest, who surveyed India, solved this problem without the aid of instruments, thus: From AB measure some distance AC and from AP measure the same distance AD measure DC and bisect it in E, then $\frac{EC}{AC}$, which is known, $=$ Sin $\frac{PAB}{2}$ hence the angle PAB is found with a measuring tape and a book of trigonometrical tables without any instrument for surveying angles. Proceed in the same way to find the angle PBA and then find AP as before, AB being, of course, duly measured.

199. Half the difficulty of solving many problems as to heights is in drawing the figures, and seeing the angles when drawn in perspective. I have frequently found it very useful, especially when the planes on which the measurements are made, are not horizontal, to draw them on cards, and actually bend the cards to the necessary angle, and through points in the figure, drawn on the inclined plane, insert pins vertically to the horizontal plane.

200. Here is a problem in angles of which the goniometrical ratios are known. A person wishing to know the height of an inaccessible tower, measures equal distances (100 yards) AB BC in a horizontal line, and observes the angles of elevation at A, B, C, to be 30°, 45°, and 60° respectively. Find the height of the tower.

Note.—The tower is not in the same line with ABC. If it were so, we should only require 2 observations.



Let DE be the tower. Let its height $= h$.

$$AE = h \cdot \cot 30° = \sqrt{3} \cdot h$$
$$BE = h \cdot \cot 45° = h$$
$$CE = h \cdot \cot 60° = \frac{1}{\sqrt{3}} h.$$

From Form. 30 in triangle EAB

$$\cos EAB = \frac{100^2 + 3h^2 - h^2}{2 \cdot 100 \cdot \sqrt{3} \cdot h}$$

again cos EAB in triangle EAC

$$= \frac{200^2 + 3h^2 - \frac{h^2}{3}}{2 \cdot 200 \cdot \sqrt{3} \cdot h}$$

equating these values of cos EAB

$$2 \cdot 100^2 + 4h^2 = 4 \cdot 100^2 + 3h^2 - \frac{h^2}{3}$$

$$h^2 + \frac{h^2}{3} = 2 \cdot 100^2$$

$$4h^2 = 3 \cdot 2 \cdot 100^2$$

$$\therefore h = \sqrt{\tfrac{3}{2}} \cdot 100 \text{ yds.}$$

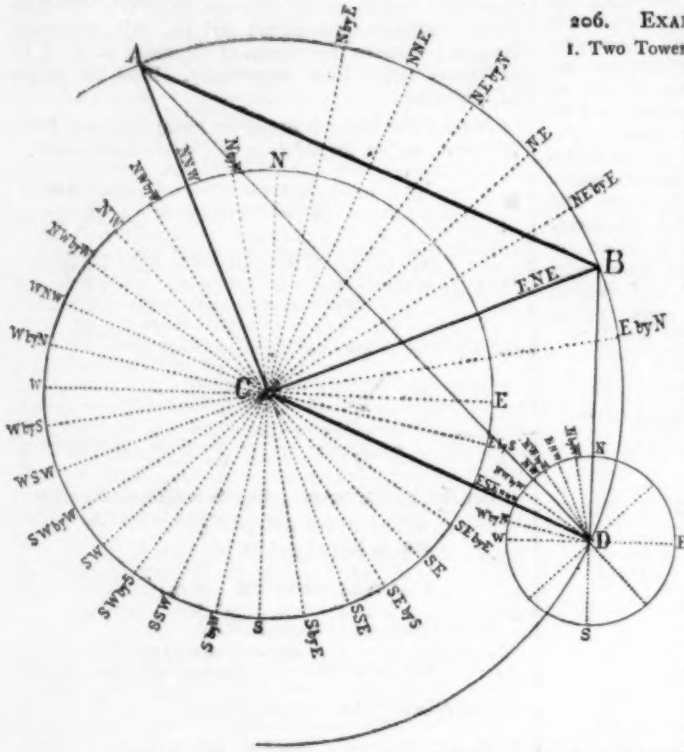
201. The distance EF, from the foot of the tower to the line ABC (produced if necessary), we leave to the student to find. The Ans. being $\frac{1}{\sqrt{2}} \cdot 100$ yds.

202. The student is supposed to know the Mariner's Compass, in which the circle is divided into 32 equal parts called points, each point containing $11\frac{1}{4}°$. We will give the names of the 7 points in the North East Quadrant, see Fig. to Par. 204.

The nearest point to the N. is called North by East and is written N. by E., the next is called North North East (N.N.E.), the next North East by North (N.E. by N.), the next North East (N.E.), the remaining ones being N.E. by E., E.N.E., and E. by N., which is within $11\frac{1}{4}°$ of due East.

203. The angle then that the courses of two ships, sailing respectively say N.N.E. and E by N, make with one another, is 5 points or $56\frac{1}{4}°$.

204. Here is a problem on the subject.



Let A and B be two points on a shore visible from a spot at sea (marked C).

It is noticed that A is N.N.W., and B E.N.E. from C.

The ship sails one mile E.S.E. to D, when it is noticed that A is N.W. and B due N. of D.

Find the distance AB.

Angle ACD = 135° and CDA = $22\frac{1}{2}°$

$\therefore$ CAD = $22\frac{1}{2}°$

$$\frac{AD}{CD} = \frac{\sin 135°}{\sin 22\frac{1}{2}}$$

$$\therefore AD = 1 \text{ mile} \times \frac{1}{\sqrt{2}} . \operatorname{cosec} 22\tfrac{1}{2}$$

Angle BDA = 45°. ABD = $112\frac{1}{2}°$ $\therefore$ BAD = $22\frac{1}{2}$

$$\frac{AB}{AD} = \frac{\sin 45°}{\sin 112\frac{1}{2}°}$$

$$\therefore AB = AD \times \frac{1}{\sqrt{2}} . \operatorname{cosec} 67\tfrac{1}{2}$$

$$\therefore AB = 1 \text{ mile} \times \tfrac{1}{2} . \operatorname{cosec} 22\tfrac{1}{2} . \sec 22\tfrac{1}{2}$$

$$= 1 \text{ mile} \times \frac{1}{\sin 45°}$$

$$= 1 \text{ mile} \times \sqrt{2}$$

$$= 1{\cdot}4142136\ldots \text{ miles.}$$

The student will see that the above could have been solved without the aid of Trigonometry, since the lines CA, CB, CD can easily be shown to be equal to each other, and the angle ACB is a right angle; hence AB is the diagonal of the square of which CB or CD (1 mile) is a side.

205. Other problems will be given at the end of this and of following chapters, of which the solutions will be found in the succeeding issues.

206. Examination and Examples, XIV.

1. Two Towers stand on a horizontal plane 156 feet apart. A person standing at the foot of each Tower observes the angle of elevation of one Tower to be double that of the other, but when he is half-way between them, the angle of elevation of one Tower is the complement of the angle of elevation of the other. Show that the heights of the Towers are 117 and 52 feet respectively.

2. The angles of depression of the top and bottom of a column observed from a Tower 144 feet high are 45° and 60° respectively: find the height of the column.

3. Wishing to ascertain the breadth of a river, I measure a line on the bank = 100 feet. I then observe that the angles subtended at the ends of the line by a tree on the opposite bank, and close to the stream, are respectively 60° and 45°. Find the breadth of the river.

4. A fortress was observed by a ship at sea to bear E.N.E., and after sailing four miles to the East it was found to bear N.N.E. Find the distance of the fortress from the ship at the first observation.

5. A ship which is known to be sailing due East at 10 miles an hour, was observed at noon to be 15° to the East of South; at 1 hour 30 minutes after noon the ship was seen in the South East: determine the distance of the ship at noon.

6. The aspect of a wall 9 ft. high is due south, and the length of the shadow cast on the north side at noon is 18 ft. Find the angle of elevation of the sun above the horizon.

7. The angular elevation of a Tower at a place A due S. of it is 45°, at a place B, due W. of A, and at a distance a from it, the elevation is 30°. Find the height of the Tower.

8. The courses of two ships are N. and E., and their rates of sailing are equal; the bearing of the former with respect to the latter was E.N.E., but after each had sailed four miles the bearing was N.N.W.: determine the distance between the ships at the time of the first observation.

9. The angles of elevation (30°, 45°, 60°) of a balloon are taken simultaneously at three points, A, C, and B, in the same horizontal line, AC = CB = 100 yds. Find the height of balloon.

10. A Tower 51 feet high has a mark at the height of 25 feet from the ground; find at what distance the two parts subtend equal angles to an eye at the height of 5 feet from the ground.

11. A person walking along a straight road observes the greatest elevation of a Tower to be 60°. From another straight road he observes the greatest elevation of the Tower to be 45°. The distances of points of observations from the intersection of the two roads are 200 and 100 yds. respectively. Find height of the Tower.

12. The top of a staff 50 ft. high is noticed by an observer on the top of a Tower 100 ft. high to have an angle of depression 30°. Find the distance the staff is from the Tower.

13. The angle of elevation of a Tower 100 feet high due North of an observer = 45°; what will be its elevation after walking due East 200 feet.

14. If a Tower stands at the foot of a hill whose inclination to the horizon is 9°, and if from a point 100 feet up the hill the Tower subtends an angle of 54°. Find its height.

15. The shadows of two walls which run at right angles to each other, and which are respectively 40 and 50 feet high, are observed when the sun is due S., and found to be 60 and 70 feet broad respectively. Find the inclination of the first wall to the meridian.

16. A man observes that when he has walked c feet up an inclined plane the angular depression of an object in the horizontal plane through the foot of the slope is A; and that when he has walked a further distance of c feet the angular depression of the same object is B. Show that the inclination of the slope to the horizon is $\cot^{-1}[2 \cot B - \cot A]$.

17. Determine the distance of the object observed from the foot of the slope in 16.

18. While sailing S.W. two ships are seen at anchor, one N.N.W. and the other W.N.W. After sailing 5 miles these ships are seen N. and N.W. respectively. Determine their bearing from each other.

19. Determine the distance of the two ships in 18 from each other.

20. A straight flagstaff, leaning due East, is found to subtend an angle a at a point in the plane upon which it stands, a yards west of the base. At a point b yards east of the base the flagstaff subtends an angle B. Find at what angle it leans.

21. A stick lying on a slope makes angles A and B with the vertical and with the horizontal line drawn on the slope: show that the inclination of the slope to the horizon is $\sin^{-1}\frac{\cos A}{\sin B}$.

22. From the place of a spectator at C, two objects A, B, known to be distant by 100 yards from one another, bear both due North, A being nearer. After walking a certain distance due East, A bears N.W. and B 30° to West of North. Find the distance walked.

23. From a point on a hill side the angle of elevation of the top of an obelisk on its summit is observed to be A, and a feet nearer to the top of the hill, to be B: show that if h be the height of the obelisk, the inclination of the hill to the horizon at the lower place of observation will be $\cos^{-1}\left\{\frac{a \sin A \sin B}{h \sin (B - A)}\right\}$.

24. If A and B be due South and East respectively from C; and A be distant from B 65 poles; and the perpendicular from C on the straight line joining A and B be 30 poles. Find the distance from C to A.

25. In 24, find the angle CBA.

(To be continued.)

The Naas Slöjd.

BY MISS J. WARREN,

Inspectress of Infant Schools to the Leicester Board.

THE twenty-first model is a wooden rake-head about two feet in length, and one inch thick. It is curved and planed with the small and American planes. The principal operation is that of boring, and then there was a rectangular double slot to make for the insertion of the handle. The work in this model was not so difficult, but needed very careful attention. The boring for the teeth of the rake had to be very regular, but we experienced great difficulty with the small bore; hitherto, with one exception, we had not made more than one hole in any model, but now we were to get practice in doing about fifteen. We did not make the teeth nor the handle for this rake, but in a former model, the hat rail (*eighteenth*), we had been prepared for this.

The model is finished with scraper, plane, file, and finally with sand-paper; the small bores are cleaned out with a twisted piece of sand-paper. I should think a good substitute for this model would be a smaller hat rail with medium holes.

The twenty-second model I thought at the time very difficult; it is a very pretty footstool. Most of the work is planing. I have before observed that from time to time we had models that were specially given for the practice in different tools. This footstool was made upon two curved supports, upon which were nailed laths of wood, each of which required four planed sides; to get the ends of these pieces flush we used a very heavy measure with which we fixed the lath fast, and then with the largest plane smoothed the edges. The narrowest sides of these slips were little more than half an inch, and we had constantly to test the levelness of the planing with a set square, the slightest dip on either side had to be rectified, otherwise they would not have fitted on to the two curved feet.

Now a word or two about these feet—by the way this was the only work in the Slöjd for which we had a drawn plan—they were curved very prettily, and before doing this, after preparing the blocks with the plane, the plan was drawn out with geometrical instruments, all the work being done with the frame saw and curved or round file. It took more than a day to complete the model. The nailing being a new feature, for the sake of those who may not understand the treatment of nails in such a thing as this, I shall just spend a few minutes in explanation.

First, then, the nails had to be prepared for use by knocking their heads off. We placed them one by one upon our iron pegs, which we pulled out of the bench for the purpose. With the iron hammer we struck the head of the nail, thus crushing off the loose iron at either side of the shaft. When prepared in this way we drove them home, and after using the hammer until the nail was level with the surface we drove it still further by putting a small file end upon it, giving it at once a sharp and dexterous blow which, if well done, would carry the already mutilated and diminished end below the surface of the wood. By this means we were enabled to hide the nail altogether, for after having nailed the laths upon the foot stands we planed them over lightly, and only by a very minute slit could their presence be detected. Since coming back to England I have suggested this plan to several friends, who were delighted with the result of their trial. I have no doubt it is well known to carpenters and joiners. Nevertheless, the fact serves to show how very useful even a little instruction in the use of ordinary tools may be made.

This footstool is a most useful thing for a Slöjd course where the children are permitted to take home their models, for in no household could it be said that such a thing may not from time to time be wanted.

I now come to the twenty-third model, consisting of a spoon. A spoon with a handle fourteen inches long, thus quite different from any gone before, and having a bowl four inches in its greater diameter. My readers will no doubt remember my remarks as to the great care needed in the selection of both sound and suitable wood for these spoons. We have now to remember that this model required a solid rectangular block of wood about twenty inches long, eight thick, and eight broad. The work with the delightful little Slöjd knife is again called into play, and also that of the American plane, the other spoons we had held in our hands to shape the handles after carving out the bowls with chisel and spoonknife, but this was too large, and had to be fixed firmly by screw to the bench. The first work was of course with frame saw to get the handle a bit into shape, and indeed before this to take off the superfluous wood with an axe. After just scooping out the bowl of the spoon this could with great dexterity be easily done. The Slöjd teacher, Herr Hewanson, would use the axe indeed just as far as we used the axe, saw, and plane, leaving a mere modicum of the work to be done with finer tools; thus were we sometimes able to see the result of 'skilled labour' and trained hands, but for the sake of the formative part of the education intended to be imparted by Slöjd I must here again explain that such exhibitions of his skill were infrequent, and not practised on *our* work. Whenever occasion called for such a display, wood was taken for the purpose, and found its way into the general chip heap afterwards. I cannot impress this too much upon teachers. The moral effect is one that a very young child may feel. There is never the joy in work completed with help that there is in work completed without it.

I must now proceed to describe our next model, *the twenty-fourth.* I can only hope to make this partially intelligible to English ears. It is an article in size and shape resembling a small cricket bat, and everyone to whom I have shown it in England has so designated it, but in point of fact it is an instrument used in washing linen, as we soon discovered, for women were constantly to be seen standing in and by the side of the brooks, wielding this bat-like thing to and fro, very much in the same way that a woman stirs paste for a pudding with a pudding spoon, and a very picturesque study they made.

The '*linen-beater*' is made of birch wood and differs from the bat in that it is convex on one side, and correspondingly concave on the other.

The tools used are the axe for first cutting, followed by the frame saw for shaping, the set square for testing the accuracy of its sides, edges, and the like, four different planes—the rough, the curved, the large, and the American; the chisel in different sizes; the file, in different shapes, and, finally, the little 'sickling,' or scraper, a tool by the way that I fell into the error of despising once in the presence of Mr. Salomon who took the opportunity of administering a sharp and well merited rebuke.

This model took some hours to complete, the practice with the curved plane being somewhat difficult, but withal very useful. If not for additional strength I quite fail to see the necessity of its shape. It will at once be seen that as a substitute for this those who wish to adopt a series of articles may easily put in its place a child's bat, as we in our country should certainly find no need for such a thing as a linen washer. Indeed, if washing machines reach much greater perfection, according to recent advertisements, we shall need no labour in the washing of clothes at all.

The twenty-fifth model is a spoon with a large bowl and a small handle, better understood if I call it a curved scoop, such as our housekeepers use in their flour bins or sugar casks, a most useful article, I feel sure, for during my many lectures and exhibitions of articles in England, my friends have boldly begged to be presented with one of the six or seven I have made, and I fear that every spoon I possess belongs properly to several ladies, each of whom confidently expects one to turn up when I have finished displaying it to the general public. This scoop is made of alder wood, but I observe that spoons used for stirring liquids, either hot or cold, are not wrought in such soft wood. Still, the elder used by us was both old and seasoned; though even then we found it much easier of treatment than that immediately preceding it. A great deal of the wood in the bowl was removed with a good sized chisel, the convex side of bowl being dealt with in a like manner to the long handled spoon, except that much could be accomplished with the frame saw.

Since writing my last article I have been in consultation with my friend, who is to start a Slöjd Class in London, and find that the peculiar tool used in the concave part of the spoon is not made in England. One has been made for her, but it is utterly unlike it (and also unfit for the work). With patience I have no doubt this can be produced, for I have yet to learn that any foreign country can make better tools than ourselves.

(To be continued.)

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Animal Physiology.

BY ARTHUR NEWSHOLME, M.D., AND C.S.S. (LOND.)

THE URINARY EXCRETION.—(*continued.*)

THE composition of the urine varies greatly under different conditions, there being no fluid in the body in which the proportion of the different constituents is so variable.

Variations with Age and Sex.

The variations occurring at different ages and in the two sexes are due partly to different conditions of nutrition and exercise, and partly to differences of food. In the earliest periods of life, our knowledge of the urine is very imperfect. Between the ages of three and seven the amount of urea excreted in proportion to the weight of the body, is about double that in the adult. The amount of water excreted by children is more than double that of adults in proportion to the weight

of the body; and the amount of chlorides is about three times as great. From eight years of age to eighteen the urine becomes gradually reduced to the adult standard.

The absolute amount of urinary excretion in women is less than in men, but the difference is not great, and it can easily be explained by the fact that women usually do less physical and mental work than men.

Variations at different times.

The influence of food on the secretion of urine is so great that it is difficult to eliminate its effects in discussing the influence of exercise, sleep, season, period of day, &c. Stating generally, however, it is well known that with a warm and dry atmosphere the quantity of water in the urine is diminished, and its proportion of solid matters is correspondingly increased; the reverse condition obtaining when from any cause the action of the skin is diminished.

Usually the urine first passed in the morning is dense and high coloured, that passed during the forenoon pale and of low specific gravity, while later in the day it becomes again of a higher specific gravity and colour. The acidity is also liable to daily variations.

Variations from Food.

Liquids increase the proportion of water in the urine, and diminish its specific gravity. It is noteworthy, however, that when large quantities of water have been drunk, the total amount of solid excretions by the urine is increased; water apparently aiding the processes of metabolism.

The results of Lehmann's experiments show that the amount of urea excreted depends closely on the nature of the food which is taken. Thus on a purely animal diet there were often two-fifths more urea excreted than on a mixed diet; on a mixed diet, there was almost one-third more than on a purely vegetable diet; while finally on a non-nitrogenous diet, the amount of urea was less than one-half the quantity excreted during an ordinary mixed diet.

Alcohol has a retarding influence on the metabolic functions of the body, and hence diminishes the excretion of urea. Tea and coffee are commonly said to have the same effect, but this has been shown to be an error of experiment, their restorative action being due to their tonic influence on the nervous system, and not to any injurious interference with metabolism.

Influence of Muscular Exercise.

Many experiments have been made to demonstrate the effect of muscular exercise on the urinary excretion, and with somewhat contradictory results. The amount of carbonic acid gas eliminated by the lungs is greatly increased during exercise, but it is not certain that the elimination of urea is increased. The following observations by Dr. Pavy, on Weston, the pedestrian, show that during excessive walking most of the urinary constituents are increased; but it must be remembered that the diet was not uniform, and much of the increased elimination might be due to increased food, and not to any metabolic changes in the muscular substance.

Taking the amount excreted at rest as one, it was found that the following changes occurred:—

Constituents.	Rest.	Walking.
Urea	1 ...	1·743
Uric Acid	1 ...	1·287
Chlorine	1 ...	·478
Sulphuric Acid	1 ...	1·520
Phosphoric Acid ...	1 ...	1·985
Soda	1 ...	·822
Potash	1 ...	1·424
Lime	1 ...	1·559
Magnesia	1 ...	·989

More recent experiments show conclusively that comparing two periods of rest and exercise, in both of which no nitrogenous food is taken, in the period of exercise there is no increase, and may actually be a decrease in the amount of urea eliminated. In ordinary cases it has been found that the increase of urea may be in the period of rest succeeding exercise. Practically it is found that well-fed persons taking exercise require a little more nitrogenous food than others at rest, but that the quantity of non-nitrogenous food requires to be increased in a much larger proportion.

Influence of Mental Exertion.

The secretion of urine is often considerably modified through the nervous system. Any severe and violent emotion may cause a sudden and copious secretion of watery urine. Intense mental exertion sometimes has the same effect.

It has been assumed that increase of elimination of phosphates out of proportion to the increase of the other solid constituents of the urine, is a constant effect of intellectual effort. Experiments, however, prove that mental efforts are accompanied by an increase of all the urinary solids, and not to any disproportionate extent of phosphates.

The study of the exact mechanism of the urinary excretion involves the consideration of (1) the relation of blood pressure to urinary excretion, and (2) the functions of renal epithelium, and (3) the method of formation of urea.

Influence of Blood Pressure.

Conditions of blood pressure have great influence on the secretion of urine. Any rise in the pressure of blood increases the urinary flow, while if the blood pressure is lowered the flow of urine is correspondingly decreased. The precise influence of special nerves on the secretion of urine has not been clearly worked out. Bernard, in his important experiments on the production of artificial diabetes in animals, found that when irritation was applied in the median line to the floor of the fourth ventricle of the medulla oblongata, at the point between the origin of the vagus and auditory nerves, the urine was increased in quantity, and became loaded with sugar. When the irritation was applied a little above this point, the urine was simply increased in quantity, and contained no sugar; while if the puncture was made a little below, sugar appeared in the urine, but without the secretion being increased in quantity.

The influence of increased blood pressure in causing a greater secretion of urine is shown by the fact that during digestion, when the blood is considerably increased in volume, a larger amount of urine is formed.

The well-known close relationship existing between the skin and kidneys is another instance of the same phenomenon. Thus, when the skin is cold, its blood-vessels are contracted. Through the medium of the vaso-motor nervous mechanism, the increased internal blood pressure caused by the contraction of the cutaneous arteries, produces a greater flow of blood to the kidneys, and consequently the amount of urine is increased. Conversely when the skin is warm and its arteries dilated (especially if perspiration occurs) the general blood pressure is diminished, and the urine is diminished in amount.

Functions of Renal Epithelium. The secretion of urine seems so closely dependent on blood-pressure, that many observers have concluded that the process is simply one of diffusion, of filtration from the blood vessels into the renal tubules. The Malpighian bodies show an arrangement very analogous to that existing in the alveoli of the lungs. In the latter the epithelium is reduced to a minimum, and the diffusion of gases easily occurs through the very delicate membrane; and similarly the epithelium covering the convoluted tufts of epithelium in the Malpighian bodies is very delicate and thin, and the passage of fluid through it must be chiefly a matter of filtration. It will be remembered that serum-albumin, one of the chief constituents of the blood, is not diffusible (*i.e.*, is a *colloid* substance), while the urea, uric acid and saline substances which occur in urine are *crystalloids* (*i.e.*, diffusible through animal membranes). Some experiments of Heidenhain, however, clearly show that the process is not one simply of filtration, but that the cells, more particularly of the convoluted tubules, are actively engaged in forming urea or in separating it from the blood.

Heidenhain took several animals and divided the spinal cord below the medulla (thus greatly lowering the blood-pressure and stopping the flow of urine). He then injected indigo-carmine (sodium sulphindigotate) into the veins, and having killed the animals at varying intervals, he found that the pigment so injected passed from the blood into the renal cells, and thence into the channels of the tubules, where it was precipitated in a solid form. There being no flow of fluid owing to the preliminary section of the spinal cord, the pigment remained where the renal cells deposited it. No traces of pigment passed through the Malpighian tufts.

The action of the epithelium may be compared to that of the epithelium of the intestinal villi, which takes up fat from the intestine and passes it on into the lacteal.

Heidenhain's experiments seem to render it certain that the view of the urinary secretion originally propounded by Bowman is the correct one, viz., that there is (1) a passive mechanical filtration of water and salts through the Malpighian tufts, and (2) an active secretion of urea, &c., by the renal epithelium lining the tubes beyond the Malpighian bodies.

Method of Formation of Urea. The urea being secreted by the renal epithelium, the question remains, is it formed by these, or simply separated by them from the blood. The latter seems more probable, at any rate in a modified form. It is certain at any rate that proteids do not become transformed into urea in the kidney. It is not so certain, however, that kreatin, and certain other bodies which are intermediate between the complex proteid and comparatively simple urea, are not transformed into urea by the activity of the renal cells.

Urea is always present in the blood, and has been found in the chyle, in serous fluids, and in saliva. It is highly probable, therefore, that some at least of the urea is formed elsewhere than in the kidneys (doubtless in the liver). The results of extirpation of the kidneys have hitherto been contradictory, some asserting that the urea in blood is increased, while others deny this. The arguments tending to show that the liver forms a large amount of urea from leucin and tyrosin have been given in a former chapter, and it may be regarded as certain that if some of the urea is formed in the renal epithelium from kreatin, a larger portion is simply separated from the blood by the same epithelium.

(To be continued.)

Pupil Teachers' Examination Papers,

OCTOBER 30TH, 1886.

QUESTIONS WITH MODEL ANSWERS.

Pupil Teachers at the end of the First Year.

Three hours and a half allowed.

Arithmetic.

BOYS ONLY.

1. (*a*) Define a fraction, a compound fraction, and a complex fraction; and give an example of each.

(*b*) Divide $7\frac{1}{3} - 5\frac{1}{4}$ of $1\frac{1}{4}$ by $4\frac{1}{2}$ of $2\frac{1}{3} + 2\frac{3}{4}$.

(*a*) A *fraction* is a quantity less than a unit, or a quantity that does not consist of an exact number of units. Thus $\frac{3}{4}$ is a fraction, being less than a unit, $\frac{4}{3}$ is a fraction in form, and does not contain a unit an exact number of times.

A *compound fraction* is a fraction of a fraction, as $\frac{2}{3}$ of $\frac{4}{5}$.

A *complex fraction* is one in which a fraction or a mixed number forms the numerator or the denominator, or both. $\frac{\frac{1}{2}}{4}$, $\frac{2}{3\frac{1}{2}}$, $\frac{3\frac{1}{2}}{4\frac{1}{4}}$ are examples of complex fractions.

(*b*)
$$\begin{aligned}
&(7\tfrac{1}{3} - 5\tfrac{1}{4} \text{ of } 1\tfrac{1}{4}) \div (4\tfrac{1}{2} \text{ of } 2\tfrac{1}{3} + 2\tfrac{3}{4}) \\
&= (\tfrac{22}{3} - \tfrac{11}{4} \text{ of } \tfrac{5}{4}) \div (\tfrac{9}{2} \text{ of } \tfrac{7}{3} + \tfrac{11}{4}) \\
&= (\tfrac{22}{3} - \tfrac{55}{16}) \div (\tfrac{21}{2} + \tfrac{11}{4}) \\
&= \frac{176 - 99}{24} \div \frac{198 + 55}{20} \\
&= \tfrac{77}{24} \times \tfrac{20}{253} \\
&= \frac{7 \times 5}{6 \times 23} = \frac{35}{138}. \quad \text{Ans.}
\end{aligned}$$

2. (*a*) What is meant by a recurring decimal? Give the rule for converting (1) a pure, (2) a mixed recurring decimal into a vulgar fraction.

(*b*) Express 42·08$\frac{3}{4}$, ·1108, ·428571, and ·5454 as fractions in their lowest terms.

(*a*) A recurring decimal is a fraction expressed in the decimal form by a series of digits repeated in the same order indefinitely. It results from the division of a number which contains other prime factors than 2 or 5. If one digit recurs a dot is placed over it to indicate the repetition, if two or more digits form the recurring period a dot is placed over the first and last. ·$\dot{3}$; ·$\dot{1}\dot{9}$; 5·6$\dot{3}\dot{7}\dot{4}$; and ·4$\dot{1}\dot{6}$ are examples of recurring decimals; the first and fourth are pure recurring decimals, and the other two are mixed.

(1) To convert a pure recurring decimal into a vulgar fraction, put for a numerator the digits of the repeating period, and for a denominator the figure 9 repeated as many times as there are digits in the repeating period.

(2) To convert a mixed recurring decimal into a vulgar fraction, take the number formed by the non-recurring digits from the number formed by all the figures to the end of the first period; place the remainder as numerator, and put for denominator the number formed by as many 9s as there are recurring digits, followed by as many ciphers as there are non-recurring digits.

In each case the resulting fraction should be reduced to its lowest terms.

(*b*) $42{\cdot}08\dot{3} = 42 + \frac{83-8}{900} = 42\frac{75}{900} = 42\frac{1}{12}$.

$\cdot 1\dot{1}0\dot{8} = \frac{1108-1}{9990} = \frac{1107}{9990} = \frac{123}{1110} = \frac{41}{370}$.

$\cdot 428571 = \frac{428571}{999999} = \frac{3}{7}$.

$\cdot 5\dot{4}5\dot{4} = \frac{5454-54}{9900} = \frac{5400}{9900} = \frac{6}{11}$.

$42\frac{1}{12}, \frac{41}{370}, \frac{3}{7}, \frac{6}{11}$. Ans.

3. Find the exact value of $\frac{9}{16}$ of a crown + $\frac{3}{8}$ of $\frac{5}{7}$ of half-a-guinea − $\frac{1}{5}$ of a florin.

$\frac{9}{16}$ of 5s. + $\frac{3}{8}$ of $\frac{5}{7}$ of 10½s. − $\frac{1}{5}$ of 2s.

$= \frac{45}{16}$s. + $\frac{3}{8}$ of $\frac{5}{7}$ of $\frac{21}{2}$s. − $\frac{2}{5}$s.

$= \frac{45}{16}$s. + $\frac{15}{56}$s. − $\frac{2}{5}$s.

$= \frac{1125 + 1296 - 160}{720}$s. $= \frac{2421 - 160}{720}$s. $= 3\frac{101}{720}$s. = 3s. $1\frac{41}{80}$d.

3s. $1\frac{41}{80}$d. Ans.

4. A man spent ·25 of his money, then ·4 of what was left, and afterwards ·3 of the remainder, and he found he had £752 left; how much had he at first?

After spending ·25 of his money ·75 remains.

" " ·4 of ·75, the remainder = ·6 of ·75 = ·45.

And after spending ·3 of ·45, the remainder = ·6 of ·45 or ·3.

If ·3 of the man's money = £752.

The original sum = £752 × $\frac{10}{3}$ = £2506 13s. 4d. Ans.

GIRLS ONLY.

1. A person takes to market a certain sum of money, $\frac{3}{4}$ of which amounts to 1½ guineas. He buys 15 score of eggs at 6½d. a dozen. What money does he take home?

Since $\frac{3}{4}$ of the sum taken = £1 11s. 6d.

$\frac{1}{4}$ " " = 15s. 9d.

and the whole sum = £2 7s. 3d.

15 score of eggs or 300 at 6½d. per dozen cost 6½d. × 25 = 13s. 6½d.

Therefore the amount taken home = £2 7s. 3d. − 13s. 6½d. = £1 13s. 8½d. Ans.

2. Take $\frac{1}{12} \div 2\frac{1}{3}$ from the greatest of the following fractions: $\frac{5}{12}$, $\frac{3}{5}$, $\frac{7}{10}$, $\frac{1}{2}$.

L.C.D. of fractions = 60.

Then $\frac{5}{12}, \frac{3}{5}, \frac{7}{10}, \frac{1}{2} = \frac{25, 36, 42, 15}{60}$

$\therefore$ $\frac{42}{60}$ that is $\frac{7}{10}$ is the greatest fraction.

And $\frac{7}{10} - (\frac{1}{12} \div 2\frac{1}{3}) = \frac{7}{10} - (\frac{1}{12} \times \frac{3}{7})$

$= \frac{7}{10} - \frac{1}{28} = \frac{49-2}{70} = \frac{47}{70}$. Ans.

3. What change should I receive out of 100 guineas, after buying three gold cups, each weighing 4 oz. 12 dwts. 21 grs., if gold is valued at £3 19s. 6d. per ounce?

		£3	19	6	= cost of 1 oz.	
				4		
		15	18	0	= "	4 ozs.
10 dwts. of 1 oz.	= ½	1	19	9	= "	10 dwts.
2½ " " 10 dwts.	= ¼		9	11¼	= "	2½ "
6 grs. " 2½ "	= $\frac{1}{120}$			$11\frac{42}{120}$	= "	6 grs.
3 " " 6 grs.	= $\frac{1}{2}$			$5\frac{7}{10}$	= "	3 "
		18	9	$2\frac{11}{10}$	= "	1 cup.
				3		
		55	7	$6\frac{33}{10}$	= "	3 cups.
100 guineas =		£105	0	0		
deduct		55	7	$6\frac{33}{10}$		
		£49	12	$5\frac{17}{10}$	Ans.	

4. Make out in proper form and receipt the following:—

4, Pilgrim Street,
Ludgate Hill, E.C.,
Oct. 30th, 1886.

Charles Justice,

Bought of Joseph Hughes.

	£	s.	d.
5 doz. slates @ 3 for 10½d.	0	17	6
6 score pencils @ 5½d. per half dozen	0	8	9
18 boxes chalk @ 1s. 5½d. per box	1	5	10½
½ gal. ink @ 2½ per half pint	0	1	8
	2	13	9½

Payment received same time,

J. HUGHES.

Grammar.

BOYS AND GIRLS.

1. '*Returning then* the bolt he *drew*,
And the *lock's* murmurs growled *anew*.
Roused at the sound, from *lowly* bed
A captive *feebly raised his* head.'

Analyse this passage, and parse the words in italics.

CLAUSE	KIND	CONNECTIVE	SUBJECT WITH ENLARGEMENTS	PREDICATE	OBJECT	EXTENSION
(*a*) Returning then the bolt he drew,	Principal		He returning	drew	the bolt	then (*Time*)
(*b*) And the lock's murmurs, growled anew.	Principal co-ordinate to (*a*)	And	murmurs the lock's	groaned		anew (*Time*)
(*c*) Roused at the sound, from lowly bed, A captive feebly raised his head.	Principal		A captive Roused at the sound	raised	his head	from lowly bed (*Place*) feebly (*Manner*)

Returning—participle, present, of reg. intrans. verb 'return,' attributive to subject 'he.'
then—adverb of time, modifying verb 'drew.'
drew—verb, irreg. trans., indic. mood, past indef. tense, 3rd person, sing. num., agreeing with subject 'he,' parts *draw, drew, drawn.*
lock's—noun, common, sing. num., neut. gend., possessive case, attributive to 'murmurs.'
anew—adverb of time, modifying verb 'growled.'
Roused—participle, passive, of reg. trans. verb 'rouse,' attributive to 'captive.'
lowly—adjective of quality. Positive degree, attributive to 'bed.'
feebly—adverb of manner, modifying verb 'raised.'
raised—verb, reg. trans., indic. mood, past indef. tense, 3rd pers., sing. numb., agreeing with subject 'captive.'
his—pronoun, personal, 3rd pers., sing. num., mas. gend., possessive case, attributive to 'head.'

2. What is the meaning of the following English terminations:—less, hood, ling, ly? Give words in which they occur.

Less—means *without.* It is added to nouns to make adjectives, as *landless, childless, careless.*
hood—means *state of being.* It is added to some nouns to make abstract nouns; as *childhood, manhood.*
ling—means *young* or *little.* It is added to some nouns to make diminutives, as *duckling, gosling* (from *goose*).
ly—means *like.* This termination is added to nouns to make adjectives as *manly, lovely;* and also to adjectives to make adverbs as *mildly, oddly.*

3. What is an adjective? State, with examples, the different kinds of adjectives.

An adjective is a word which limits the application of a noun by expressing some attribute or distinction of the object signified by the noun.

Adjectives may be divided into four classes:—

(1) Adjectives of quality, as *good, proud, careful, joyous.*

(2) Adjectives of quantity, as *much, little, some.*

(3) Adjectives of number, as *two, five, many, few.*

The first two of these examples are sometimes called definite numerals, and cardinal numerals, the last two are indefinite adjectives of number.

(4) Adjectives of distinction, as *the, this, that, yon, other, second, third.* The last two examples are of the class sometimes called ordinal numerals; the first mentioned are often called demonstrative adjectives.

Such words as *his, my,* often called possessive adjectives, are pronouns in the possessive case, and as such are attributive to nouns.

Geography.

(Do *three* questions only.)

1. The Black Country, the Fens, the Lothians, the New Forest, the Bog of Allen, the Lake District, Connemara, the Highlands. Describe briefly the situation and character of each of these.

The Black Country is the district which occupies the southern portion of Staffordshire, and stretches into Worcestershire and the north of Warwickshire. It receives the name from the coal mines, foundries, and furnaces which abound there, and mark the neighbourhood as one of dreariness and blackness. The surface of the district is but little varied, but it is invested with much interest on account of the great industries and great towns which have sprung up about the mines and iron works. The chief towns are Birmingham, Wolverhampton, Walsall, Bilston, Dudley, West Bromwich, Wednesbury. Perhaps the most striking idea of the character of the Black Country is obtained by travelling through it at night, at a time when plentiful trade causes all the vast furnaces to be aglow, and the sky is lighted up by their lurid fires.

The Fens form a large flat, marshy district bordering the Wash, and extending into several counties, Lincoln, Cambridgeshire, Huntingdonshire, and Norfolk. A large portion of the Fens was formerly under water; but within the last two centuries great drainage works have been planned and carried out, and what was once little but waste is now to a considerable extent fertile ground. In many places the canals for draining the country are prevented from inundating the land by raised embankments.

The Lothians are three counties in Scotland on the south shore of the Firth of Forth, namely, Linlithgow, or West Lothian, Edinburgh, or Midlothian, and Haddington, or East Lothian. The district is one of the most fertile and the best cultivated in Britain. The land is hilly, but not mountainous as so much of Scotland is; and the farmers are among the most enterprising and prosperous in the world. Several towns of note are included in the Lothians, but grandest among them all is the beautiful city of Edinburgh, the modern Athens.

The New Forest is a large tract of well-wooded land in the south of Hampshire. It was laid out as a forest for the pleasure of William the Conqueror and the other Norman Kings. Many villages were destroyed to make this hunting ground. Now it is a pleasant fertile district, abounding in beautiful woodland scenery, noted for its ponies, and possessing still many old-fashioned villages, as Ringwood, Brockenhurst, Lyndhurst.

The Bog of Allen stretches across the north of the central part of Ireland, from the Liffey to the west of the Shannon. It is a region in which the ground for many miles is of a soft spongy nature having been formed by the decay of vegetables in a country abounding in moisture. The bog-lands are not very productive, but people obtain from them peat which they use as a substitute for coal. The layer of peat is 20 to 30 feet thick.

The Lake District occupies a large part of Cumberland and Westmoreland, and stretches into Lancashire. It is probably the most diversified and the most beautiful part of England. It contains not only all the important English lakes, but also the highest English mountains. Among the former may be named Windermere, Ulleswater, Coniston, Derwentwater, Grasmere, Rydal Water, and among the latter Helveilyn, Scafell, Skiddaw, the Langdale Pikes, Honister Crag. All these names bring to the mind of one who has travelled through the district scenery of astonishing beauty and grandeur. There are many famous waterfalls in the district: Scale Force, Lodore, Stock Gill Force, Rydal Falls.

Connemara is a tract of wild land to the north of Galway, noted for its beautiful scenery. The name means 'Bays of the Sea.' It contains some large lakes called Loughs Corrib and Mask; and there are hills around them—one of the most famous being called the Twelve Pins. The prevailing rainy weather is a drawback to enjoyment; but it is to that cause that Ireland owes its beautiful green, which has obtained for it the name of the Emerald Isle.

The Highlands form a very large part of Scotland, reaching to the extreme north and west from a line running obliquely across the middle of the country. The Highlands include the counties of Perth, Aberdeen, Inverness, Ross, Caithness, Argyle, Sutherland. The district contains the highest mountains and the largest lakes in Great Britain. The scenery is very beautiful, in some parts grand and romantic, in others delicately pretty.

2. Give as good an account as you can of a voyage to Australia or Canada, and say all you know about Queensland or Nova Scotia.

Excellent steamers ply between England and Canada at all seasons. The shortest passage from Liverpool to Quebec or Montreal is that by way of the north of Ireland and the north of Newfoundland. The time from land to land by this way is usually only six days. But as it is only available in the summer we take the rather longer route which keeps further south, and proceeds to Halifax, the chief town of Nova Scotia.

Starting from Liverpool we steam out of the Mersey, keeping in a direction almost exactly west, till we reach the north-western corner of Anglesea. Here we turn to the south, and pass Holyhead. Keeping well out in the St. George's Channel we pass between the shores of Wales and Ireland. Next we turn to to the west, steaming to the south of Ireland, calling, if need be, at Queenstown, the port of Cork. Our way now lies very slightly to the south of west right across the Atlantic till we reach St. John's, the capital of Newfoundland; and for seven or eight days we have no sight of land, but must content ourselves with such entertainment as the variations of the weather may afford, or as may be found in the occupations and amusements which are possible on board a well-appointed steamer. From St. John's we continue our voyage south-west to Halifax. Hence we might make our way across Nova Scotia and New Brunswick by railway to Montreal, crossing the St. Lawrence by the Victoria Bridge; or we might in a favourable season proceed by steamer round the north of Cape Breton Island, and so enter the Gulf of St. Lawrence. Keeping to the south of Anticosti we should pass up the river St. Lawrence, and so reach Quebec, Three Rivers, or Montreal.

Stopping however for a time at Halifax we may improve our knowledge of the peninsula of Nova Scotia, of which it is the capital. The name means New Scotland, and commemorates the fact that Charles I. and James I. endeavoured to form there a Scotch colony. By the Treaty of Breda the land was ceded to France, in whose possession it remained till 1713. Nova Scotia consists of a peninsula and the Island of Cape Breton, which together occupy an area of 22,000 square miles. Formerly this was covered with forests, and is still well-wooded. The surface is pleasantly varied. There is a picturesque range of hills running through the peninsula. There are also several lakes, the inland waters covering an area of about 3,000 square miles. Most of the land is fertile. Mineral wealth is abundant, especially coal, iron, and gypsum. Some gold is also found. The coast is very extensive, and possesses several good harbours. South of the peninsula lies a heap of sand called Sable Island, and on the west is the Bay of Fundy, famous for its very high tides. In Nova Scotia lies the valley made famous by Longfellow's 'Evangeline.' There are several railways in the country. A lieutenant-governor appointed by the Dominion Government, an executive council of nine members, and an elective assembly of 38 members form the government of the province.

3. Describe the river basin of the St. Lawrence, or of the Murray, or of the Severn.

The basin of the St. Lawrence includes almost the whole of Canada Proper, and a great part of the United States; and it would be impossible to give with sufficient brevity a detailed description of the complete river basin. It is chiefly remarkable for the great system of fresh water lakes, which occupy a very large area. It has indeed been estimated that the basin of the St. Lawrence contains half the fresh water of the world. A little stream rising in the heart of North America, and called the St. Louis, may be called the source of the St. Lawrence, for it forms the chief river flowing into Lake Superior, the highest of the great chain of lakes. This lake has an area of about 32,000 square miles. A short river called the St. Mary connects Superior with Huron, another large lake, and passing through we leave on our right another, somewhat larger, called Lake Michigan, which is entirely in the United States. From Huron to Erie, the next large lake to the east, we can pass by a small river which expands into a lake on its way. From Erie to Ontario steamers have to go by a canal to avoid the passage by the Niagara, famous for its wonderful falls and rapids. After leaving Lake Ontario we enter the stream properly called the St. Lawrence, which soon expands into what is called the Lake of the 'Thousand Isles.' The main river then receives the Ottawa, on which the Dominion capital stands, and then flows on to Montreal, where it is spanned by the remarkable Victoria Tubular Bridge. After this it gradually expands until it becomes the great Gulf of St. Lawrence with several large islands—Anticosti, Cape Breton, Prince Edward's Island, and Newfoundland almost barring its way to the Atlantic. The scenery on the shores of the great lakes is very beautiful. During the present century many large towns have sprung up, and a rapidly-increasing traffic is carried on by the magnificent waterway supplied by the great lakes and their connecting rivers and canals. The basin of the St. Lawrence abounds in timber, and yields excellent crops of corn in its cultivated portion, and in the more remote districts fur-bearing animals are plentiful. The greatest drawback is the severity of the winter, which puts a check upon navigation and hinders the labours of the farmers. Many large streams contribute their waters to the lakes, and several tributaries join the St. Lawrence in its lower course.

4. Draw a map of Scotland north of the Caledonian Canal, or of Connaught and Ulster.

History.

1. When did Britain become a Province of the Roman Empire? Explain the meaning of the phrase.

Britain was formed into a Province of the Roman Empire by the Emperor Claudius, after his campaign of 43 A.D. The result of Julius Cæsar's visits nearly a century earlier was to establish a very slight and diminishing authority over the Britons.

The word *province* is derived from the Latin *pro* or *procul*, at a distance, and *vinco*, I conquer, and was applied to the more remote territories conquered by the Romans. Britain was called a province of the Roman Empire because, like other distant lands brought under Roman rule, its government was directly dependent on the Emperor, and not on the Senate.

2. Describe the territories which formed the kingdoms of Wessex and Mercia.

The portion of Britain which constituted the kingdom of Wessex was that which lay to the south of the Thames, and reached from the present counties of Surrey and Sussex almost to Cornwall. The latter district was never conquered while the Saxon tribes existed as separate kingdoms; and the boundaries of Wessex like those of all the Saxon kingdoms were never very well defined, because of the continual changes consequent upon the wars which so often prevailed between the different tribes. Under its later kings Wessex absorbed the smaller states on its eastern borders.

The kingdom of Mercia, the last formed of the Saxon States, extended over the central portion of the country, having the Humber and Ribble to the north, East Anglia on the east, Middlesex and the Thames on the south, and Wales on the west. As in the case of Wessex the boundaries were uncertain, and changing with the victories and defeats of its kings. The name Mercia is a Latinised form of March or boundary, a name applied by the Angles to the lands west of their own territory of East Anglia.

3. How was Edward the Confessor connected with Normandy? Tell the name and parentage of his wife.

Edward the Confessor was the son of Ethelred II. by his second wife, Emma, daughter of Richard, Duke of Normandy. As Emma was sister of William the Conqueror's grandfather, Richard II. of Normandy, Edward was first cousin to William's father, Robert the Devil. Much of Edward's early life was spent in Normandy, and during the usurpation of Canute he was protected by his uncle, Richard I. Through this training, no doubt, he contracted that partiality for Normans which made him less fit for ruling his English subjects, and probably smoothed the way for the Norman conquest. Edward married Edith or Edgitha, daughter of the powerful Earl Godwin, whose son Harold succeeded to the throne in 1066. His marriage to Edith was in fulfilment of an agreement made in order to secure Earl Godwin's support in obtaining the crown for Edward.

Composition.

Write from memory the substance of the passage read to you by the inspector.

[The passage should be read *once* distinctly, and then the substance of it is to be written down from memory by the pupil-teacher.]

The elephant's trunk is formed of numbers of muscular fibres, amounting to at least 40,000, which take various directions, and cross each other in so many ways, that the whole forms one of the most flexible organs that can be conceived. It can be contracted, raised, depressed, curved, turned, or twisted round any object at the will of its possessor; and can lay hold of, and pick up the most minute and the thinnest substance, aided in such instances by the prolongation of its upper edge into what is called a finger, which protects the nostrils, and acts as a feeler. This trunk serves as a reservoir for holding liquid, which can be put into the mouth at pleasure, by inserting the end between the jaws; or for retaining it as long as may be wished, when it is discharged over any object which the elephant desires to inundate. He occasionally pours it upon his own body, thereby not only cooling and refreshing himself, but getting rid of the numerous insects which lodge themselves in his hide. The trumpet-like noise, for which elephants are remarkable, proceeds from their trunk, and it serves in other ways to express their feelings, for with it they bestow their caresses.

Music.

A quarter of an hour allowed for this paper.

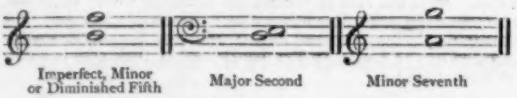
N.B.—Pupil Teachers may answer the questions in either the staff notation or the tonic sol-fa, but *not both*. The questions in the tonic sol-fa notation will be found at the end.

STAFF NOTATION.

Pupil Teachers at end of First Year.

1. Re-write the following (1) doubling the value of every note, and (2) state below each its pitch name (as E or *Mi*, &c.)

2. Write below each of the following intervals its name:



Imperfect, Minor or Diminished Fifth — Major Second — Minor Seventh

3. Add *one* note to each of the following examples to complete the bar in accordance with the time-signature:

TONIC SOL-FA NOTATION.

1. What is the name of the interval (1) between *te*$_1$ and *fah*, (2) between *ray* and *me*, (3) between *lah*$_1$ and *soh*.

(1) Minor, imperfect or diminished fifth.
(2) Major second.
(3) Minor seventh.

2. Write the pulse signs (1) for two-pulse measure, (2) for our-pulse measure, and (3) for three-pulse measure.

(1) | : ‖
(2) | : | : ‖
(3) | : : ‖

3. Write (using three pulse measure) one note four pulses, another three pulses, and another two pulses in value,

| m : — : — | — : s : — | — : d : — ‖

Needlework.

GIRLS ONLY.

(One hour allowed for this exercise.)

Make a band 3 inches long, and 1 inch wide. Join two pieces of calico together by a sew-and-fell seam 2 inches long. Gather and stroke a length of 6 inches, and set it into the band. Put on a tape at the end of the band.

Pupil Teachers at end of Second Year.

FIRST PAPER.

(Three hours and a half allowed.)

Euclid.

BOYS ONLY.

[All generally understood abbreviations and symbols for words may be used, but not symbols of operation, such as —, +, ×.]

(Answer *two* questions, including Question 3, if you can do so.)

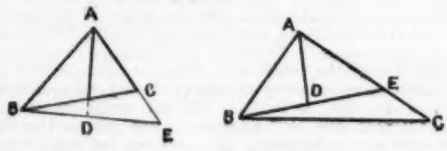
1. If two angles of a triangle be equal to each other, the sides also which subtend, or are opposite to, the equal angles, shall be equal to one another.

Book I. Proposition 6.

2. If at a point in a straight line, two other straight lines, upon the opposite sides of it, make the adjacent angles together equal to two right angles, then these two straight lines shall be in one and the same straight line.

Book I. Proposition 14.

3. AD bisects the angle A of the triangle ABC, and BDE perpendicular to AD, meets AC (produced if necessary) at E. Show that BD is equal to DE.



Because AD bisects the angle BAC, the angle BAD is equal to the angle DAE, and because BDE is at right angles to AD, the angle ADB is equal to the angle ADE.

Therefore the two triangles ADB, ADE, have two angles of the one equal to two angles of the other, each to each. Also the side AD adjacent to the equal angles is common to both.

Therefore the remaining sides of the triangle ABD are equal to the remaining sides of the triangle ADE, each to each to which equal angles are opposite, that is AB equal to AE, and BD equal to DE. (I. 26.) Q.E.D.

Arithmetic.

GIRLS ONLY.

1. Find the value of $\frac{3}{4}$ of £1 + ·6 of a guinea − $\frac{2}{3}$ of 6s. 8d. + ·03 of a crown − $\frac{3}{10}$ of a shilling.

Value required
= 17s. 6d. + $\frac{6}{5}$s. − $\frac{13\text{s. }4\text{d.}}{3}$ + $\frac{3}{10}$s. − $\frac{3}{10}$s.
= 17s. 6d. + 12s. 7½d. − 4s. 5½d. + 1½d. − 2¼d.
= 30s. 3d. − 4s. 7$\frac{7}{12}$d.
= 25s. 7$\frac{5}{12}$ = £1 5s. 7$\frac{5}{12}$d. Ans.

2. A person spends $\frac{3}{4}$ of his money, then $\frac{1}{3}$ of the remainder, and then $\frac{1}{2}$ of what he still has left. He finally had £7 in hand. How much had he at first?

After spending $\frac{3}{4}$ of his money, the remainder is $\frac{1}{4}$.
After spending $\frac{1}{3}$ of $\frac{1}{4}$, the remainder is $\frac{2}{3}$ of $\frac{1}{4}$, that is $\frac{2}{12}$.
And after spending $\frac{1}{2}$ of $\frac{2}{12}$, the remainder is $\frac{1}{2}$ of $\frac{2}{12}$, that is $\frac{1}{12}$.
Therefore $\frac{1}{12}$ of the original sum is £7.
$\frac{1}{12}$ = £1, and the whole = £36.

3. Simplify $\frac{3\frac{1}{2} + 2\frac{1}{4} - 4\frac{1}{2}}{1\frac{3}{4} \div \frac{3}{8}} \times \frac{4}{15}$

$= \frac{3\frac{1}{2} + 2\frac{1}{4} - 4\frac{1}{2}}{1\frac{3}{4} + \frac{3}{8}} \times \frac{4}{15}$

$= \frac{3\frac{2}{8} + 2\frac{2}{8} - 4\frac{4}{8}}{1\frac{3}{4} \times \frac{8}{3}} \times \frac{4}{15}$

$= 1 \times \frac{1}{7} \times \frac{8}{3} \times \frac{4}{15}$

$= \frac{1 \times 4 \times 1 \times 5}{7 \times 1 \times 8} = \frac{5}{21}$. Ans.

4. Express as a decimal fraction:—

$\frac{2}{3} + 1\frac{1}{2}$ of $\frac{3}{4} - \frac{1}{2} \div \frac{2}{3}$
$\frac{2}{3} + 1\frac{1}{2}$ of $\frac{3}{4} - \frac{1}{2} + \frac{2}{3}$
$= \frac{2}{3} + \frac{3}{2}$ of $\frac{3}{4} - \frac{1}{2} \times \frac{2}{3}$
$= \frac{2}{3} + \frac{9}{8} - \frac{3}{4}$
$= ·625 + ·7 - ·6 = ·025 + ·7 = ·802\frac{1}{2}$. Ans.

5. Suppose a postage stamp to be 1 inch long and $\frac{1}{4}$ of an inch broad. How many will be required for papering a room which is 16 feet 10 inches long, 15 feet 9 inches broad, and 12 feet 6 inches high?

Area of wall surface = distance round room × height.
= (202 in. + 189 in.) × 2 × 150 in. = 391 in. × 2 × 150 in. = 117,300 sq. in.
∴ No. of postage stamps required = 117,300 sq. in. ÷ $\frac{1}{4}$ sq. in.
= 117,300 × 4 = 117,300 + 29,325 = 146,625. Ans.

Grammar.

BOYS AND GIRLS.

1. '*There* are, *who* have at *midnight* hour
In slumber *scaled* a dizzy tower,
And, on the *verge that beetled o'er*
The ocean *tide's incessant* roar,
Dreamed calmly out their dangerous dream
Till wakened by the morning beam.'

Turn this passage into prose.

Some persons while fast asleep have risen in the middle of the night, and under the influence of dreams have climbed to the top of some lofty turret, and there on a ledge that overhung the ever-rolling, ever-boisterous waves of the sea, have continued dreaming, calm and unconscious of their perilous position, until the light of dawn has roused them from their sleep.

2. Analyse the above passage, and parse the words in italics.

A. There are (some) Principal Clause.

B. Who have at midnight hour
In slumber scaled a dizzy tower.
Adjective Clause, attributive to subject of A.

C. And) on the verge
Dreamed calmly out their dangerous dream.
Adjective Clause, attributive to subject of A.
Co-ordinate to B.

D. That beetled o'er
The ocean tide's incessant roar.
Adjective Clause, attributive to 'verge' in C.

E. Till) (they have been) wakened by the morning beam.
Adverbial Clause, denoting time, and modifying
Predicate of C., contracted in subject.

Clause	Connective	Subject	Predicate with Complement	Object with Enlargements	Extensions of Predicate
A		[Some persons]	are there		
B		who	have scaled	a dizzy tower	in slumber (*Manner*) at midnight hour (*Time*)
C	And	[who]	[have] dreamed	their dangerous dream	calmly (*Manner*) out (*Manner*) on the verge (*Place*)
D		that	beetled		o'er the ocean tide's incessant roar (*Place*)
E	Till	[they]	[have been] wakened		by the morning beam (*Manner*)

There—adverb of place, here used idiomatically as complement or necessary part of predicate 'are.'
who—pronoun, relative, 3rd pers., plur. num., com. gend., agreeing with its antecedent 'persons' understood. nom. case, subject to 'have scaled.'
midnight—adjective of quality, attributive to 'hour;' or noun used as adjective.
scaled—verb, reg. trans., perfect participle, forming with 'have' predicate to subject 'who.'
verge—noun, com., sing. num., neut. gend., objective case, governed by preposition 'on.'
that—pronoun, relative, 3rd pers., sing. num., neut. gend., agreeing with its antecedent 'verge,' nomin. case, subject to 'beetled.'
beetled—verb, reg. intrans., indic. mood, past indef. tense, 3rd pers., sing. num., agreeing with its subject 'that.'
o'er (over)—preposition governing 'roar.'
tide's—noun, com., singular num, neut. gend., possessive case, attributive to 'roar.'
incessant—adjective of quality, attributive to 'roar.'
dreamed—verb, reg. intrans., used as transitive, perfect participle, forming with 'have' understood predicate to 'who.'
calmly—adverb of manner, modifying 'dreamed.'
out—adverb of manner, modifying 'dreamed.'
till—conjunction, adverbial, introducing clause denoting time.
wakened—verb, irreg. trans., passive participle, forming with 'have been' understood the predicate of 'they' understood.

3. What are some of the principal terminations of nouns formed from the Latin? Give words in which they occur.

tion, state of being, or act—restoration, institution, action, perdition.
sion, similarly used—passion, occasion, evasion, prevision.
ion, which might be made to include the two previous forms—coercion, opinion, region.
or, a person—doctor, pastor, orator, governor.
ate, a person—advocate.
ity, a quality or state—voracity, velocity, ferocity, opportunity.
ety, a quality or state—satiety, variety, society, propriety.
ery, a quality or state—misery.
ance, act, or state of being—appearance, attendance.
ence, same as last form—existence, dependence, diffidence.
tude, state or quality—solitude, magnitude, longitude, desuetude.
acy, state or quality—accuracy, degeneracy, delicacy.

Geography.

(Do *three* questions only.)

1. What are the different productions of the East and West Indies, and how do they reach our shores?

The chief productions of the East Indies are spices, including cloves, cinnamon, mace, nutmegs, pepper; india-rubber, gutta-percha, camphor, indigo, gamboge, opium, and other drugs; cotton, coffee, rice, sago, and rich fruits; teak and other timber, sandal-wood, and other ornamental woods; diamonds and precious stones; wool and silk. Large quantities of these products are brought over to England by sailing vessels and steamers. In some cases the vessels cross the Indian Ocean in a south-westerly direction, passing Madagascar and rounding the Cape of Good Hope. Then they sail northward through the Atlantic Ocean, and reach Southampton or London by way of the Bay of Biscay and the English Channel. But the quickest way, and one which is becoming more and more used, is that through the Suez Canal. When vessels from the East Indian ports take that route, they cross the Indian Ocean to the north of the equator, and enter the Red Sea by the Straits of Bab-el-Mandeb, passing Aden. Then voyaging in a north-westerly direction they reach Suez, and pass along the Canal to Port Said. Next they turn west along the Mediterranean Sea, and after passing through the Strait of Gibraltar they go along the shores of Spain and Portugal, cross the Bay of Biscay and enter the English Channel, by which they arrive at Southampton, or, going up the mouth of the Thames, they reach the docks at London.

The productions of the West Indies are tropical like those of the East Indies. They include cotton, sugar, rum, molasses, pine-apples, cocoa-nuts, tomatoes, oranges, and other fruits;

arrow-root, maize, cocoa, coffee, tobacco, lime juice; dye woods, cabinet woods, drugs and spices. The products of the West Indies are brought to England by steamers and sailing vessels, which cross the Atlantic in the track of the Gulf Stream, which helps them along, and proceeding up the Bristol Channel, they land their cargoes at Bristol, or, traversing the English Channel, enter the mouth of the Thames, and are unloaded at the London Docks.

2. 'Longitude is a question of time.' Explain this, and show how a sailor in the middle of the Atlantic will find out his latitude and longitude.

By longitude we mean distance in an easterly or westerly direction. Now, since the earth turns round on its axis in 24 hours, and its circumference is divided into 360 degrees, it is obvious that any point on its surface moves through 15 degrees in one hour, or one degree in four minutes. Hence a difference of one degree in longitude is equal to four minutes in time; thus, as the earth rotates from west to east, the sun will reach its highest position, that is, it will be midday at any place four minutes earlier than it will at another place one degree further west, and four minutes later than it will at a place one degree further east. A similar remark might be made respecting the position of the fixed stars.

The knowledge of this connection between longitude and time enables a sailor to find his longitude whenever he has an opportunity to observe the sun or the stars. The instruments he requires are a mariner's compass, that he may know in what direction he looks for the sun or the star he is observing, and a chronometer or time-keeper that will not vary with different climate, or other circumstances. The chronometer having been set at the beginning of the voyage by the time at Greenwich, which is adopted as the standard, he may notice what time it indicates when the position of the sun shows it is mid-day at the place of observation. The difference in the time indicated may be reduced to minutes and divided by four, and the result will indicate the number of degrees of longitude of the place. In the middle of the Atlantic the time of the chronometer will be after mid-day, and the longitude will be west. If the place of observation were in the Indian Ocean, the chronometer would show the time earlier than mid-day, and the longitude would be east. When the stars are observed instead of the sun, the sailor will have to refer to the nautical almanac, or to a chart of the stars, to ascertain the correct time at which they appear in a certain position.

Having found his longitude as already explained, the sailor could find his latitude by the use of the sextant, which will enable him to ascertain the declination of the sun, or the number of degrees it is above the horizon. When he has determined this, a reference to the nautical almanac will enable him to determine his latitude, for it will show him how many degrees from the equator, north or south, he must be for the sun to have that declination at that particular time. The same principle is used when the observation is taken by some fixed star instead of the sun.

3. Describe a voyage from the mouth of the Vistula to that of the Tagus, or from the mouth of the Indus to that of the Ganges, naming anything of interest by the way.

Let us set sail from Kurrachee, a rising port near the frontier of India towards Beluchistan, and a short distance west of the mouth of the Indus. Sailing to the south-west we pass the several openings by which this great river reaches the sea, after a course of 1,800 miles from its sources in the Himalayas, during which it receives several large tributaries, flows through fertile valleys and desert plains, and washes down great quantities of mud, which help to form its delta. Continuing in the same direction we pass a great opening called the Gulf of Cutch, which contains a long and rather level island of the same name. Then rounding the peninsula of Guzerat we come to the Gulf of Cambay, which pierces the country in a northerly direction, and so helps to form the peninsula, and which receives the river Nerbudda. On the east side of this gulf, at the mouth of the river Taptee, is situated Surat, the earliest established trading station of the English in India, and one of the best known ports for the export of cotton. Proceeding now directly to the south we soon arrive at the great port of Bombay, which stands on an island near the coast. It is famous for its extensive trade, and for the wonderful caves of Elephanta on another island in the neighbourhood. Sailing southward along the coast we notice a range of mountains running almost parallel with the shore, and only a short distance inland; these are the Western Ghauts. On our way we pass the Portuguese settlement of Goa, and then the town of Mangalore, and soon we come to Calicut, the first port in India visited by Vasco de Gama, after he had rounded the Cape of Good Hope, and noted also as the place from which calico is named. Looking inland we should now be able to discern the conical summits of the Neilgherry Hills, and looking seawards in the distance on the horizon the Laccadine Islands in a somewhat scattered group. Passing Cochin and Trivandrum we reach the end of the western or Malabar coast at Cape Comorin. Here we turn for some miles to the east, and then northwards into the Gulf of Manaar and Palk's Straits. This channel, which separates the remarkable tropical island of Ceylon from the mainland, is crossed by a reef or ridge of rocks called Adam's Bridge. On that account we should not be able to go through it except that our ship is rather small. Issuing from the strait we turn round Point Calimere, and proceed along the Coromandel coast, passing the several mouths of the Cauvery with the towns of Tanjore and Tranquebar. Soon we come to Pondicherry, a French trading station, and a little further north is Madras, the chief town in the south of India. As Madras has no harbour the only way to land is by means of surf-boats; the ships and steamers have to lie in the roads at a distance from the shore. Still proceeding northwards we pass the mouths of the Pennaar, Kistnah, and Godavery rivers, which rise in the Western Ghauts, drain part of the Deccan, break through the less continuous range of the Eastern Ghauts, and fall into the Bay of Bengal. We leave Masulipatam and sail along a monotonous coast to the mouths of the Mahanuddy, on one of which stands Juggernaut, the sacred town famous for its great idol and self-sacrificing pilgrims. A comparatively short distance to the north-west we reach the Hooghley, the only navigable mouth of the great river Ganges, and sailing a hundred miles up this we reach our destination, Calcutta, the capital of our Indian Empire.

4. Draw a map of Denmark, of Greece, or of Ceylon.

SECOND PAPER.

Two hours and a half allowed.

GIRLS ONLY.

Needlework.

(*One hour allowed for this Exercise.*)

Fix a calico patch 2 inches square. Complete not less than half of it on both right and wrong sides. Make a button-hole and sew on a button.

BOYS ONLY.

Arithmetic.

1. (*a*) Define simple and compound interest. (*b*) Find the compound interest on £1,250 for 3 years at 4½ per cent. per annum.

(*a*) Interest is a payment made for the use of money borrowed. It is called Simple Interest when it is paid at a certain rate in proportion to the amount lent, which is called the principal, and in proportion also to the time for which it is lent.

When the sum due for a certain period, usually a year, is added to the principal, and the interest for the next period is calculated on the increased principal, to which the new interest is again added to make the principal for the next period, and so on; the total interest thus accumulated during the time the money is lent is called Compound Interest.

(*b*) Interest on £1250 for 1 year at 4½ per cent.
= £12 10s. × 4½ = 56 5s.

Interest on 1306 5s. for 1 year at 4½ per cent.
= £13 1s. 3d. × 4½ = 58 15s. 7½d.

Interest on 1365 0s. 7½d. for 1 year at 4½ per cent.
= £13 13s. $0\frac{3}{8}$d. × 4½ = 61 8s. $6\frac{47}{80}$d.

1426 9s. $1\frac{87}{80}$d.
Deduct principal = 1250 0s. 0d.
Total interest = £ 176 9s. $1\frac{87}{80}$d. Ans.

2. In a school in which 120 scholars were examined, the average percentage of passes was 85, and the number who passed in reading and writing were 114 and 100 respectively. What was the number of passes in arithmetic?

Total number of passes possible = 120 × 3 = 360.
Actual number of passes = 85 per cent. of 360 = 360 × $\frac{17}{20}$ = 306.
∴ number of passes in arithmetic = 306 − (114 + 100) =
306 − 214 = 92. Ans.

3. If a man sells £28,000 out of the 3 per cents. at 101⅛ and invests the proceeds in 4 per cent. railway stock at £125, what will be the difference in his income, brokerage being omitted?

Income from £28,000 in 3 per cents. = £280 × 3 = £840.
Proceeds of sale of £28,000 at 101⅛ = £280 × 101⅛ = £28,525.
Income from investment in 4 per cent. stock at 125 =

$$\frac{28525 \times 4}{125} = \frac{1141 \times 4}{5} = \frac{4564}{5} = £912\ 16s.$$

Therefore, difference of income = £912 16s. − £840 = £72 16s. increase. Ans.

4. If ·0625 ozs. of gold be worth £·2421875, what will ·0375 of a ton be worth?

·0625 oz. is worth £·2421875.
∴ 625 oz. ,, £2421·875.
∴ 1 oz. ,, £2421·875 ÷ 625 = £3·875 = £3⅞.
∴ 1 lb. ,, £3⅞ × 16 = £62.

And ·0375, or $\frac{3}{80}$ of a ton = 3 qrs. = 84 lbs., is worth £62 × 84 = £5208. Ans.

History.

BOYS AND GIRLS.

1. How did William the Conqueror deal with the estates of the English?

After the victory of Hastings, which placed William of Normandy on the English throne, the new king's rule met with long continued resistance from the English nobles. But William was unsparing in his efforts to crush revolt, and merciless in his dealings with those who opposed his authority. The struggle made by the nobles against the king ended in the complete subjugation of the country by the Norman leader, who seized all the lands of the conquered nobles. These lands the conqueror divided into baronies or knights' fees, and bestowed them as rewards on his Norman subjects, who held them on condition of rendering military service to him as their feudal lord. Thus was introduced the Norman form of the feudal system, under which all the land was considered the property of the king, and the landholders were vassals bound to help the king when he should need them. The larger holdings were subdivided and let out by the barons to under-tenants on similar conditions, and thus was provided a means whereby the king could call to his aid an army of 60,000 knights.

2. When and where was the battle of the Standard fought? Why was it so called?

The battle of the Standard was fought on the 22nd of August, 1138, at Northallerton, in the north of Yorkshire. It was the chief and concluding battle in a campaign undertaken by David of Scotland on behalf of his niece the Empress Maud who, as the daughter of Henry I., claimed the throne of England in opposition to Stephen of Blois. It was called the Battle of the Standard because the English, roused to determined resistance by the cruelty of Maud's Scottish partisans, gathered round Archbishop Thurston, and rallied round a remarkable standard, consisting of a pole like a ship's mast, from which the banners of the popular saints of the north were suspended, and above which rose a cross. The result of the battle was a complete victory for the English forces.

3. Tell the names and dates of the first and last sovereigns of the House of Tudor. In what respect had the second monarch of that House a better title to the throne than the first?

The first Tudor sovereign of England was Henry VII., son of Owen Tudor, and reigned from 1485 to 1509. The last was Elizabeth, daughter of Henry VIII., and she reigned from 1558 to 1603.

The claim of Henry VII. to the English throne was not undisputed, for though he was descended on his mother's side from John of Gaunt, the third son of Edward, it was from the marriage of that prince with Catherine Swynford, which, as far as the right of succession was concerned was regarded as an unlawful marriage, the issue of it having been expressly excepted from any claim to the throne. Henry, however, secured the crown by his victory at Bosworth, and his politic marriage with Elizabeth, daughter of Edward IV., and representative of the Yorkist branch of the royal line, contributed to establish him more firmly in his position.

Henry VIII., his son, was allowed to have a stronger claim, because in him the right of inheritance derived from his mother was joined with such right as could be transmitted by his father as conqueror and possessor of the crown. In fact, the succession of Henry VIII. was quite undisputed, while several rivals had troubled the early years of Henry VII.'s reign.

Teaching.

1. Point out the silent letters in light, height, which, colour, tremble.

In the word *light*, the letters *gh* are silent. They serve, however, to give the long or name sound to the preceding letter *i*.

In *height*, the silent letters are e, g, h. These also in combination modify the *i*, so as to make it long.

In *which* no letter is properly silent or unrepresented in the pronunciation, though it is a common fault to neglect the aspirate indicated by the *h*.

In *colour* the *o* is not sounded. In the original Latin form of the word, a form to which the Americans and many spelling reformers in England have reverted, the *u* does not appear. It is introduced by the transition of the word through the French, and in pronunciation it has practically superseded the *o*.

In *tremble* there is no letter really unsounded, as the word contains two syllables. The final *e*, however, is not sounded after the *l*, but contributes the vowel element to the last syllable in a somewhat imperfect form as if it were *bel*, with the close sound of the *e*.

2. What common mistakes are made by beginners in forming the small letters o, t, b, r?

The mistake a beginner is most apt to make in writing a small *o* is to begin the curve at the wrong place, particularly at the left hand side. Another mistake often accompanying this is making a bad junction of the end of the curve with the beginning. A third common mistake is imperfectly joining the *o* to the previous letter; and a fourth is making the letter round or irregular in shape instead of oval.

The most frequent faults of beginners in making a small *t* are making a sharp point at the top of the stroke, or looping the top, making it too long, or misplacing the cross mark. The last is, perhaps, the commonest of all, and it is a mistake which varies very much. For instance, the cross mark may be made too high, it may be too long, it may tend up or down instead of being horizontal, or it may be detached from the down stroke.

In making a small *b* a common fault is making the down stroke convex to the left hand, which gives the letter a squat, bulging appearance. Then the turn or crotchet on the right is sometimes turned in too much towards the principal stroke, and sometimes it is made into a loop, and so looks like a small *e*. Another fault to be guarded against is making the stroke too short, or carrying the hook below the line.

In the case of the small *r*, the mistakes made nearly always occur in making the crotchet or turn. This is sometimes made so as to curve in and touch the down stroke, sometimes it is brought down too low, and the result resembles a bad *n*, sometimes the thin line forming the up stroke of the crotchet runs up separate from the down stroke through too much of its length, and the result is something like a *v*.

3. What are the shortest processes of working mentally the following sums: 57×25, 3 doz. articles at 7½d. each, 85×99?

To multiply 57 by 25, divide 57 by 4, call the quotient hundreds, and add 25 for the 1 remaining, thus 1425. The reason of this method is easy to understand, since every four times 25 in the product makes 100.

To find the cost of 3 doz. articles at 7½d. each, reckon the cost of 1 doz. at 7½d. by taking the pence as shillings, and multiply the result (7s. 6d.) by 3, which gives £1 2s. 6d.

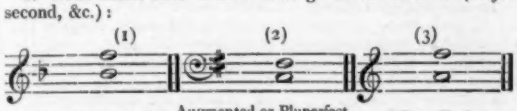
To multiply 85 by 99, take 85 from 8500 and we have the answer, 8415. The reason is that our multiplier is one less than 100.

Music.

STAFF NOTATION.

A quarter of an hour is allowed.

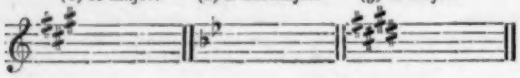
1. Write below each of the following intervals its name (major second, &c.):



Major or Perfect Fifth — Augmented or Pluperfect Fourth, or Tritone — Minor Sixth

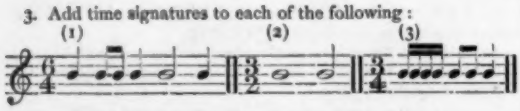
2. Write the key signatures of each of the following major keys:

(1) A major. (2) B flat major. (3) E major.



3. Add time signatures to each of the following:

(1) (2) (3)



TONIC SOL-FA NOTATION.

1. (1) Which tone of the scale has a grave solemn effect, and (2) which has a keen, expectant effect?

(1) *fah*.
(2) *te*.

2. Write (1) the pulse signs for six-pulse measure, (2) nine-pulse measure, and (3) four-pulse measure.

(1) | : : | : : ||

(2) | : : | : : | : : ||

(3) | : | : ||

3. What is the name of the interval between (1) *fah* and *doh*^{1}, (2) *fah*$_1$, and *te*$_1$, and (3) *lah* and *fah*^{1}.

(1) Perfect or major fifth.
(2) Augmented or pulperfect fourth, or tritone.
(3) Minor sixth.

Pupil Teachers at end of Third Year.

FIRST PAPER.

(Three hours and a half allowed.)

BOYS ONLY.

Euclid.

[All generally understood abbreviations for words may be used, but not symbols of operation, such as—, +, ×.]

(Answer *two* questions, including Question 3, if you can do so.)

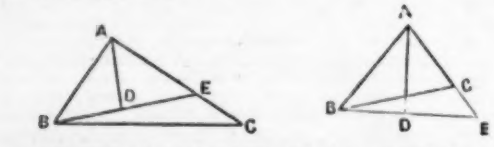
1. The opposite sides and angles of a parallelogram are equal to one another, and the diameter bisects it, that is, divides it into two equal parts.

Book I. Proposition 34.

2. To a given straight line to apply a parallelogram, which shall be equal to a given triangle, and have one of its angles equal to a given rectilineal angle.

Book I. Proposition 4.

3. AD bisects the angle A of a triangle ABC, and BDE perpendicular to AD meets AC (produced if necessary) at E. Show that the difference of the angles ACB, ABC is equal to twice the angle CBE.



In the triangles ABD, AED the angle ADB = the angle ADE, each being a right angle; and the angle BAD = the angle EAD, each being half the angle BAC (Hyp.); and the three angles of every triangle are together equal to two right angles. (I. 32.)

Therefore the remaining angle ABD = the remaining angle AED.

In the first figure, the exterior angle AEB is equal to the two interior opposite angles ECB and CBE. (I. 32.) Therefore also the ABE = the two angles ECB and CBE. To each of these equals add the angle CBE. Therefore the angle ABC is equal to the angle ACB together with twice the angle CBE.

In the second figure where AC is produced, by similar reasoning it may be shown that the angle ACB is greater than the angle ABC by twice the angle CBE. Q.E.D.

Algebra.

(Answer two Questions, including Question 2, if you can do so.)

1. Show that $(2a - 3b + 1)^3 - (1 - 3a + 2b)^3$ is divisible by $5(a - b)$.

From the formula $x^3 - y^3 = (x - y)(x^2 + xy + y^2)$ or by trial we know that $x^3 - y^3$ is divisible by $x - y$.

But the expression $(2a - 3b + 1)^3 - (1 - 3a + 2b)^3$ is of the form $x^3 - y^3$, with $(2a - 3b + 1) = x$, and $(1 - 3a + 2b) = y$.

$\therefore$ it is divisible by $(2a - 3b + 1) - (1 - 3a + 2b)$ that is by $5a - 5b$ or $5(a - b)$, which was to be proved.

2. *Prove* that $\frac{a}{b} + \frac{c}{d} = \frac{ad + b}{bd}$

Find the value of $\frac{2x}{2x - 3} - \frac{5}{6x + 9} - \frac{4(3x + 2)}{3(4x^2 - 9)}$

The numerator and denominator of a fraction correspond to the dividend and divisor in the process of division.

If the dividend and divisor be multiplied by the same multiplier the quotient remains unaltered, and in the same manner if the numerator and denominator of a fraction be multiplied by the same quantity, the value of the fraction remains the same.

That is $\frac{a}{b} = \frac{ad}{bd}$, and $\frac{c}{d} = \frac{bc}{bd}$

$\therefore \frac{a}{b} + \frac{c}{d} = \frac{ad}{bd} + \frac{bc}{bd}$, which, since the denominator of each fraction is the same, may be written $\frac{ad + bc}{bd}$.

$\therefore \frac{a}{b} + \frac{c}{d} = \frac{ad + bc}{bd}$.

$$\frac{2x}{2x - 3} - \frac{5}{6x + 9} - \frac{4(3x + 2)}{3(4x^2 - 9)}$$

$$= \frac{2x}{2x - 3} - \frac{5}{3(2x + 3)} - \frac{4(3x + 2)}{3(2x - 3)(2x + 3)}.$$

which, since the last denominator contains each of the other two,

$$= \frac{6x(2x + 3) - 5(2x - 3) - 4(3x + 2)}{3(4x^2 - 9)}$$

$$= \frac{12x^2 + 18x - 10x + 15 - 12x - 8}{3(4x^2 - 9)}$$

$$= \underline{\frac{12x^2 - 4x + 7}{3(x^2 - 9)}} \text{ Ans.}$$

3. Solve the equations—

(1) $x - \frac{1}{3}(2x - 57) = 3x - \left(\frac{2x - 5}{10} + \frac{5}{2}\right)$

(2) $\frac{6x + 7}{9x + 6} = \frac{1}{12} + \frac{5x - 5}{12x - 8}$

(1) $x - \frac{1}{3}(2x - 57) = 3x - \left(\frac{2x - 5}{10} + \frac{5}{2}\right)$

Multiply each side by 30.

$\therefore 30x - 5(2x - 57) = 90x - (6x - 15 + 50)$

Remove brackets

$\therefore 30x - 10x + 285 = 90x - 6x + 15 - 50$

Transpose $\therefore 30x - 10x - 90x + 6x = 15 - 50 - 285$

Collect $\therefore -64x = -320$

Divided by -64 $\therefore x = \underline{5}$ Ans.

(2) $\frac{6x + 7}{9x + 6} = \frac{1}{12} + \frac{5x - 5}{12x - 8}$

Multiply by L.C.D. $12(3x + 2)$

$\therefore 4(6x + 7) = 3x + 2 + 3(5x - 5)$

Remove brackets

$\therefore 24x + 28 = 3x + 2 + 15x - 15$

Subtract $18x + 28$ from each side

$\therefore 6x = -41$

$\therefore x = -\frac{41}{6} = \underline{-6\frac{5}{6}}$. Ans.

Mensuration.

(Answer *one* question.)

1. A square map, whose area is 65·205625 square inches, is mounted on a square board each of whose sides is 1·0583 feet. Find the width of the margin, which is the same each way.

Side of map = sq. root of 65·205625 sq. in.

$65\cdot205625(8\cdot075$ in. $= 8\frac{7}{10}\frac{8}{00} = 8\frac{8}{40}$ in.

64

1607 | 1·2056

11249

16145 | 80725

80725

Side of board $= 1\cdot0583$ ft. $= 1\frac{583-58}{9000} = 1\frac{525}{9000} = 1\frac{21}{360} = 1\frac{7}{120}$ ft.

$= 1\frac{7}{10} \times 12$ in. $= 12\frac{7}{10}$ in.

Then width of margin in inches $= (12\frac{7}{10} - 8\frac{8}{40}) \div 2 = 4\frac{28-3}{40} \div 2$

$= 4\frac{25}{40} \div 2 = 2\frac{25}{80} = \underline{2\frac{5}{16}}$ in. Ans.

2. One side of a right angled triangle is 119. Find the other side if its area is the same as that of a triangle whose sides (in feet) are 20, 493, 507.

$20 + 493 + 507 = 1020$; $1020 \div 2 = 510$.
$510 - 20 = 490$; $510 - 493 = 17$; $510 - 507 = 3$.
$510 \times 490 \times 17 \times 3 = 12744900$.
$\sqrt{12744900} = 3570$ = area of triangle.
Since area of right angled triangle = 3570 and one side = 119.
∴ the other side $= \frac{3570}{119} \times 2 = 30 \times 2 = \underline{60}$ ft. Ans

GIRLS ONLY.

Arithmetic.

1. A gentleman left £4,000 to be divided among his wife, son, and daughter. The wife received ·325 of it, and the son ·125 of what was left; the daughter received the remainder. What was the daughter's share worth?

Wife's share = ·325, that is, $\frac{13}{40}$ of £4000 = £1300.
Son's share = ·125 of (£4000 − £1300) = $\frac{1}{8}$ of £2700 = £337 10s.
Daughter's share = £2700 − £337 10s. = <u>£2362 10s.</u> Ans.

2. Reduce 13 ft. 11½ in. to the decimal of ½ a mile.
(N.B.—Work to 6 places of decimals.)

13 ft. 11½ in. = 13·9583 ft.

3)13·9583 ft.

220 { 10) 4·6527 yds.
22) ·46527

4)·0211489 fur.

<u>·005287 of ½ a mile.</u> Ans.

3. (*a*) Assuming 64 metres to be equal to 70 yards, express a degree (69½ miles) in metres.
(*b*) A runs 120 yards in 2 minutes.
B runs 80 yards in a minute.
How far is A behind when B has run a mile?

(*a*) No. of metres in 69½ miles $= 69\frac{1}{2} \times 1760 \times \frac{64}{70}$

$= \frac{139}{2} \times \frac{1760}{1} \times \frac{64}{70} = \frac{139 \times 176 \times 32}{7}$

$= \frac{782848}{7} = \underline{111835\frac{3}{7}}$ Ans.

(*b*) No. of minutes B takes to run a mile $= \frac{1760}{80} = 22$.

No. of yds. A runs in 22 min. $= \frac{22 \times 120}{2} = 1320$

∴ No. of yds. A is behind B = 1760 − 1320 = <u>440 yds.</u>

4. Find the value of £·625 + 1·25 guineas − ·75 crowns − 5·475 shillings + ·5 pence.

£·625 + 1·25 guineas − ·75 crowns − 5·475s. + ·5d.
$= \frac{5}{8}$ of £1 + 1¼ of 21s. − ¾ of 5s. − $5\frac{19}{40}$s. + ½d.
= 12s. 6d. + £1 6s. 3d. − 3s. 9d. − 5s. $5\frac{7}{10}$d. + ½d.
= £1 18s. 9½d. − 9s. $2\frac{7}{10}$d. = <u>£1 9s. 6¼d.</u> Ans.

Grammar.

BOYS AND GIRLS.

1. '*On through* the hamlet *as* they paced,
Before a porch, *whose* front was graced
With bush and flagon trimly *placed*,
Lord Marmion *drew* his rein:
The *village* inn seemed large, *though rude*;
Its cheerful fire and *hearty* food
Might well relieve his train.'

Turn this passage into prose.

The horsemen rode steadily through the village until they came to a house the front of whose porch was decked with a neat arrangement of those signs, the bush and flagon, which symbolised the vintner's trade and marked the house as the village inn. Here Lord Marmion pulled up his horse; for the hostel was a large one, and though there seemed to be little refinement about the place, there was promise of warmth and comfort and of wholesome refreshment for himself and his attendants.

2. Analyse the first four lines in the above passage, and parse the words in italics.

Clause A. On through the hamlet as they paced.
Adverbial Clause, denoting time and manner, modifying predicate of B.

B. Before a porch Lord Marmion drew his rein.
Principal Clause.

C. Whose front was graced
With bush and flagon trimly placed.
Adjective Clause, attributive to 'porch' in B.

CLAUSE	CONNECTIVE	SUBJECT WITH ENLARGEMENT	PREDICATE	OBJECT WITH ENLARGEMENT	EXTENSION OF PREDICATE
A.	As	they	paced		on (*place*) through the hamlet (*place*)
B.		Lord Marmion	drew	his rein	before a porch (*place*)
C.		whose front	was graced		with bush and flagon trimly placed (*manner*)

On—adverb of place, direction, modifying verb 'paced.'
through—preposition governing 'hamlet.'
as—conjunction, adverbial, introducing clause indicating time and manner.
whose—pronoun, relative, 3rd person, singular number, neuter gender, agreeing with antecedent 'porch,' possessive case, attributive to 'front.'

placed—verb, irreg. trans. passive participle, attributive to bush and flagon.
drew—verb, reg. intrans., indic. mood, past indef. tense, 3rd person, sing. numb., agreeing with subject 'Lord Marmion.'
village—adjective of quality, attributive to 'inn,' or noun used as adjective.
though—conjunction, disjunctive, connecting 'large' to 'rude.'
its—pronoun, personal, 3rd pers., sing, numb., neut. gend., possessive case, attributive to 'fire' and 'food.'
hearty—adjective of quality, attributive to 'food.'
might—verb, irreg. intrans. indic. mood, past tense in form, with future application, 3rd pers., plural num., agreeing with subjects 'fire' and 'food' = would be able.
well—adverb of manner, modifying verb 'relieve.'
relieve—verb, reg. trans., infinitive mood, depending on 'might,' and governing 'train.'

3. Servant, steward, bondage, magistrate, freedom, temperance, friendship, fortitude, arithmetic. Point out the English words in this list. How do you distinguish them?

The purely English words in this list are *steward*, *freedom*, and *friendship*. These are known by their terminations, as well as by their roots; *ard* indicates a person who, *dom* and *ship* form abstract nouns which stand for a state of being.

The word *bondage* is English in its root, *bond* from *bind*, but it has a French termination *age*, indicating state of being.

All the other words in the list are formed from Latin roots with Latin affixes, except *arithmetic*, which is from the Greek.

Geography.

(*Do three questions only.*)

1. Describe the course and causes of any of the great ocean currents.

As an important and typical current of the ocean we may take the great Equatorial current of the Atlantic Ocean. It begins near the coast of Africa rather north of the Equator. Then it flows westward towards America, and on approaching Cape St. Roque it divides into two branches, one of which flows to the south-west along the shores of Brazil, and the other to the north-west into the Caribbean Sea. Here the waters of this current and of another current which comes from the north, and enters the same sea below the surface, become hemmed in, and, being subjected to tropical heat, form the source of the wonderful warm current called the Gulf Stream.

The principal cause of ocean currents is the play of the winds upon the surface of the water. The current just described is the result of the continuous action of the trade winds, which, blowing from the north-east and from the south-east, meet near the equator at an acute angle, and drive the surface water of the Atlantic towards the west. A similar current, caused in the same way and flowing in the same general direction, is found in the equatorial regions of the Pacific Ocean. Among the causes which modify the direction and speed of currents must be noticed the position and distribution of masses of land and the variations of temperature, with the consequent differences in amount of evaporation. It should also be observed that connected with every great current there must be one or more counter-currents, which flow in an opposite direction at the sides of the main current, or below the ocean surface. These serve to keep the sea-level practically constant.

2. Show as fully as you can what are the obstacles to our acquaintance with the interior of Asia and Africa.

The main obstacles to our better acquaintance with the interior of Asia may be classed as physical and social or political. The inclemency of the Arctic shores make it impracticable to avail ourselves of the large rivers Obi, Yenesei, and Lena to cross the great northern plain of Asia. On the south of Central Asia, where the frontiers of Hindostan abut on the great table-land, a lofty and almost impassable barrier exists in the Himalaya Mountains, with their lofty peaks and ridges, in many places reaching a height of over five miles above the sea-level. The great distance of the interior of Asia from the sea constitutes another difficulty; so that even where great mountain ranges and desolate plains do not cut us off from intercourse with it, the journey is long and arduous, and there are scarcely any facilities for communication. This brings us to the political and social obstacles. The despotic government of Russia has command of nearly all the available approaches to Central Asia on the western side, while on the east the way is blocked by the empire of China. The Chinese retain most of their wonted antipathy to strangers and their opposition to modern innovations. The interior of their own country is still almost closed to foreigners, and they are not willing to facilitate the endeavours of travellers to explore the parts of Central Asia adjoining the frontiers of their vast empire.

The difficulties in the way of a more complete knowledge of Africa are also physical and political. Across almost the whole breadth of the northern half stretches the great arid plain of the Sahara, which can only be crossed with great difficulty. The way to the interior up the Niger is also beset with difficulty. Further south the great Kalahari Desert prevents communication from Cape Colony with the central part of the continent. The voyage up the Nile abounds in physical obstacles from the rocky nature of its course and the interruptions of falls and rapids. But one of the most serious difficulties in the way of reaching the interior of Africa from almost any direction, is that afforded by the savage tribes which inhabit almost every habitable district. In the gradual civilising of these tribes must lie the hope of Europeans arriving at a better knowledge of the country. Many self-sacrificing travellers have explored the courses of the great rivers, the Nile, the Niger, the Congo, and the Zambesi, and endeavoured to establish peaceful intercourse with the natives; but the fruits of these efforts are not yet very abundant. In the portions which are fertile and yet uninhabited, there is much danger to travellers from the wild beasts which largely abound.

3. Say all you know about the African and Asiatic seaports on the Mediterranean.

The chief seaports on the African coast of the Mediterranean are Algiers, Tunis, Tripoli, Alexandria, Rosetta, and Port Said.

Algiers is the chief town of the French colony of Algeria. It was formerly a stronghold of pirates, and as such was punished by the English in 1816. In 1830 it was taken by the French, and has since become much like a European town. Great improvements have been made in the neighbourhood, and it has become a resort for invalids. The town is strongly fortified, and, the houses being built on a hill facing the sea, it presents a bright and pretty appearance.

Tunis is a very large town at a short distance from the shore. It is the capital of a small state of the same name, and stands not far from the site of the ancient city of Carthage.

Tripoli is the capital of another state. The name means three cities. It is a well-built town, with considerable trade in wheat, ostrich feathers, and esparto grass, and forms the starting point for trading caravans and travellers who wish to cross the desert of Sahara to Lake Tchad and Timbuctoo.

Alexandria is the chief port of Egypt. It stands on a narrow piece of land called the Peninsula of Pharos, and is near the site of the ancient city founded by Alexander the Great. A canal connects it with the Nile. It has large trade, and much intercourse with Europeans, many representatives of whom live in the city, the portion they live in being called the European quarter. During the late war with Egypt the city was bombarded by the English; but from this disaster it has now recovered.

Rosetta is a small port near the western branch of the mouth of the Nile. Its trade has declined since the construction of the Suez Canal, but it supplies Cairo with fruit from its gardens. The famous Rosetta stone which furnished a key to the Egyptian hieroglyphics was found here. It is now in the British Museum.

Port Said stands at the entrance to the Suez Canal, and from that circumstance has rapidly developed into a place of considerable importance.

The principal Asiatic seaports on the Mediterranean are Jaffa, Acre, Beyrout, Tripoli, and Smyrna.

Jaffa is a small place, known as the Joppa of the New Testament. It is often used by travellers to Jerusalem.

Acre is a town of Syria, on the Bay of Acre, near the foot of Mount Carmel. In 1840 it was bombarded by the British fleet, and has never completely recovered from the effects. It has often been an object of attack as forming the key to Palestine. It has but a small amount of trade in corn and cotton.

Beyrout is a rather large seaport on the coast of Syria. It has inherited much of the trade which formerly belonged to the famous Phœnician towns of Tyre and Sidon, which lay rather further south. It trades especially in raw and manufactured silk, but also in drugs and dyes. Its imports supply the markets of Damascus. Beyrout is the residence of the Pasha of Damascus.

Tripoli is a smaller port of similar character, some distance further north.

Smyrna is the largest seaport of Turkey in Asia. It stands on the shores of a small bay on the eastern coast of the Ægean Sea. Trade is carried on with nearly all parts of Europe, and many foreign merchants reside in the town. It has manufactures as well as exports of textile fabrics. It also exports enormous quantities of dried fruits. Its population is about 150,000.

4. Draw a map of the eastern half of Asia or of Africa, insert the lines of latitude and longitude.

SECOND PAPER.

(Two hours and a half allowed.)

GIRLS ONLY.

Needlework.

(One hour allowed for this exercise.)

Set in a print patch 2 inches square, and darn on flannel 10 rows as for a thin place;

or,

Set in a print patch 2 inches square, and work 3 inches of stitching on a folded band of calico.

BOYS ONLY.

Arithmetic.

1. (*a*) What is meant by the terms stock, consols, brokerage, Three per Cents., and 'at par'?

(*b*) A invests money in Three per Cents. at 101$\frac{7}{8}$, and B in Four per Cent. Railway Stock at 129$\frac{7}{8}$, brokerage at 2s. 6d. per £100 being charged in each case; compare the rates of interest they get for their money.

(*a*) *Stock* is the term applied to money which has been raised by a government or corporation as a loan from persons who hold documents which contain an acknowledgment of the amount due to them, and a promise to pay interest at a certain rate per cent. and at certain intervals for its use. These documents called certificates or scrip can be transferred from one person to another, and with them passes the claim to interest. Hence the scrip itself is often spoken of as stock; and its possession is the evidence of being a holder of stock.

Consols is an abbreviation of Consolidated Stocks. It is the name applied to the English Government's funded debt, which has been incurred by loans raised at various times for different purposes, but which is now consolidated into one stock, and bears interest at one uniform rate of 3 per cent., that is £3 per annum for every bond or certificate of £100, though this bond does not necessarily or usually represent an outlay of exactly £100 by the person who holds it.

Brokerage is the term applied to the charge made by persons called stock-brokers, whose business it is to buy and sell bonds or stock certificates for other persons. It is reckoned at so much (usually 2s. 6d. or $\frac{1}{8}$) per cent. on the nominal value of the stock.

Three per Cents. are stock or funded debt bearing an interest at the rate of £3 per annum for every £100 in the nominal amount of the stock as shown by the certificates or scrip.

'*At par*' is an expression used to indicate that the price of stock is the same as its nominal value, that is, £100 will buy a certificate for £100.

(*b*) For each £100 in the 3 per cents. A pays £101$\frac{7}{8}$ + brokerage $\frac{1}{8}$, that is, £102.
∴ A's interest = £3 on an outlay of £102, or $\frac{3}{102}$.
For each £100 of Railway Stock at 4 per cent. B pays £129$\frac{7}{8}$ + brokerage $\frac{1}{8}$, that is, £130.
∴ B's interest = £4 on an outlay of £130, or $\frac{2}{65}$.
Comparing the ratio of the two rates of interest, we have
A's int. : B's :: $\frac{3}{102}$: $\frac{2}{65}$, that is, as 65 : 68.
A's int. is to B's int. as 65 is to 68. Ans.

2. (*a*) Define true discount and present worth.

(*b*) What is the present worth of a bill of £2,599 16s. 8d. due 7 months hence, interest allowed being at 4$\frac{1}{2}$ per cent. per annum?

(*a*) *True discount* is the exact allowance which should be made at a certain rate per cent. when money is paid a certain time before it is actually due, and is such that when it is deducted from the total amount payable the remainder, if immediately invested at the given rate per cent. for the given time, would produce interest exactly equal to the amount deducted.

Present worth is the sum payable at the present time as the equivalent of a larger sum due at a certain time later, and is such that, interest being reckoned at a certain rate per cent., it would in the given time amount to the total sum due. It is, in short, the remainder after true discount has been deducted.

Interest on £100 for 1 year = £4$\frac{1}{2}$.
∴ Interest on £100 for 7 months = £4$\frac{1}{2}$ × $\frac{7}{12}$ = £$\frac{21}{8}$,
And amount of £100 for 7 months = £102$\frac{5}{8}$.
That is £100 is the present worth of £102$\frac{5}{8}$.

∴ present worth of £2599 16s. 8d. = £2599$\frac{2}{3}$ × $\frac{100}{102\frac{5}{8}}$

= $\frac{15599}{6}$ × $\frac{800}{821}$ = $\frac{19 \times 400}{3}$ = $\frac{7600}{3}$ = £2533 6s. 8d. Ans.

3. Find the exact value of $\sqrt{\frac{845}{720}} + \sqrt{\frac{\cdot2 \text{ of } \cdot25}{\cdot2 \times \cdot4}}$; and the square root of ·0004389 to 5 decimal places.

$$\sqrt{\frac{845}{720}} + \sqrt{\frac{\cdot2 \text{ of } \cdot25}{\cdot2 \times \cdot4}} = \sqrt{\frac{169}{144}} + \sqrt{\frac{\frac{2}{5} \text{ of } \frac{1}{4}}{\frac{1}{5} \times \frac{8}{5}}}$$

$$= 1\tfrac{2}{12} + \sqrt{\frac{\frac{1}{10}}{\frac{8}{25}}} = 1\tfrac{1}{12} + \sqrt{\frac{25}{36}}$$

$$= 1\tfrac{1}{12} + \tfrac{5}{6} = 1\tfrac{11}{12}. \text{ Ans.}$$

4. A grocer buys one cwt. of tea for £11, and sells half of it at 2s. 6d. per lb.; at what rate per lb. must he sell the rest so as to gain 40 per cent. on the whole?

Cost of 1 cwt. = £11.

40 % on £11 = £11 × $\frac{40}{100}$ = £$\frac{22}{5}$ = £4 8s.

∴ total selling price = £11 + £4 8s. = £15 8s.
Selling price of 56 lbs. at 2s. 6d. per lb. = £56 ÷ 8 = £7.
∴ price of remaining 56 lbs. = £15 8s. − £7 = £8 8s.,
and price per lb. = £8 8s. ÷ 56 = $\frac{168s.}{56}$ = 3s. Ans.

BOYS AND GIRLS.

History.

1. What parliaments are known as 'short' and 'long'? Describe events which make the latter notorious in our history.

The Short Parliament was the fourth parliament called by Charles I. He had ruled the country for about eleven years without summoning any parliament; but, being in need of supplies, he summoned this, which met in April, 1640. As the members proceeded to discuss their grievances against the King's arbitrary government instead of at once voting the money he required, he hastily dissolved the parliament after it had sat only three weeks.

The Long Parliament was the fifth called by Charles I., and met in November, 1640. It is rendered memorable by the determined resistance it offered to the attempts of the king to establish an arbitrary government. It began its work by reversing the despotic enactments of the previous eleven years. Then the Earl of Strafford, who had been the strongest supporter of the king, was impeached and imprisoned, and afterwards condemned under a Bill of Attainder, and executed as a traitor on Tower Hill. About a year after the first meeting of the parliament a document called the Grand Remonstrance was adopted by the majority. This described and protested against the bad government of the past sixteen years. Charles in an evil moment determined to overawe the parliament by the impeachment and arrest of some of the popular leaders. The parliament stood on its privileges as an assembly of free men. The king was baffled, but continued his opposition, refusing his assent to the Militia Bill, which had for its object the transference to parliament of the control of the army. In August, 1642, Charles raised his standard at Nottingham, and thus began the great civil war which troubled the country until the royalist party were completely beaten. Success swayed first to one side and then to the other; but the decisive battle of Naseby in 1645 established the power of the parliamentary party, and practically sealed the fate of Charles. The extreme

anti-royalists gained the upper hand, and a remnant of the parliament, after the Presbyterian members who held moderate views had been excluded, resorted to the extreme measure of putting the king on his trial for treason. In the latter part of January, 1649, Charles was condemned to death, and three days later he was beheaded at Whitehall. Cromwell, who had been very prominent in the civil war and in the proceedings against the king, after this kept the command of the army, and soon came into conflict with the parliament. In 1653, in a very startling manner, he expelled the members, and so ended the work of the Long Parliament, except that in 1660, when the country had grown tired of the absence of a regular government, many of the Presbyterian members met again, and having ordered that a new parliament or convention should be elected, dissolved their own assembly.

2. The simple inscription on General Wolfe's monument, erected where he fell, was 'Died Victorious;' how, when, and where did he die?

James Wolfe was the general to whom was entrusted the command of an English army sent to attack the French under Montcalm in a strong position they held at Quebec. The place was deemed impregnable, and two other divisions which were to have joined Wolfe's in the attack upon Quebec failed to come up in time. In spite of this Wolfe, by a most masterly strategy, succeeded in posting his men during the night on the Heights of Abraham outside the town. The French were thus taken by surprise, and their forces were completely defeated. Unfortunately Wolfe was shot and died, contented to know in his last moments that his troops had won the victory. Montcalm was mortally wounded, and died the next day. The result of this famous action, which took place on the 13th of September, 1759, was that the whole of Canada fell into the hands of the English.

3. What induced our American Colonies to assert their independence? And by what means did they secure it?

At the close of the Seven Years' War in 1763, our American Colonies included the eastern part of what is now known as the United States. In 1765 the English parliament, in order to meet the cost of the late war, passed the Stamp Act, which imposed a tax on wills, contracts, and other legal documents used in America. The Colonists objected to pay taxes to Britain on the ground that they were not represented in the British Parliament. The Stamp Act was then repealed; but shortly afterwards another ministry succeeded, and the Chancellor of the Exchequer, under the Duke of Grafton, imposed duties on tea, glass, and several other articles exported to the Colonies. This met with strenuous opposition from the Colonists, and at length in 1773 some of them boarded the tea-ships in Boston Harbour and threw the cargoes into the sea. The port of Boston was closed by the English. Then the Colonists met in Congress and petitioned against the obnoxious taxes, but without success. Chatham and Burke warned the government against dealing with the Americans so scornfully, but in vain. The quarrel grew in bitterness till in 1775 some armed Americans attacked a body of English soldiers at Lexington. This was the beginning of the war. On July 4th, 1776, the Congress at Philadelphia issued the famous Declaration of Independence. Then, with varying success, battle after battle was fought until in 1781 the English general, Lord Cornwallis, was shut up in Yorktown, and compelled by General Washington to surrender with his troops. This virtually decided the issue of the war, which continued some time longer; but in 1783, by the treaty of Versailles, the Thirteen United States were acknowledged as independent.

A Republican government was then adopted with Washington for its first President.

Teaching.

FOR TEACHERS IN SCHOOLS FOR OLDER SCHOLARS.

1. Write notes of a first lesson on Adverbs.

Lesson intended for children in Standard III. who have previously been taught to distinguish the verb, noun, adjective, and pronoun in easy sentences.

Chief aim of Lesson to illustrate, explain, and impress on the children's minds the primary use of the Adverb.

Blackboard to be placed in front of class.

1. Call upon children for simple sentences containing noun and verb; adjective, noun and verb, pronoun and verb.

Take the sentence *Birds sing* as a type.

2. Ask for some other word to be added after verb.

One may say *songs*. What sort of word is this? *Noun*. Ask for some other word not a noun. Answer *sweetly*. What does this tell us? *How* the birds sing.

3. Take a number of similar sentences:—

The sun shines. How? *brightly*.

The wind blows...*coldly*. The river flows...*swiftly*.

The rain falls...*fast*.

From many examples deduce that these particular words tell *how* something is done.

4. Take the sentence 'The sun shines,' and ask what we might tell instead of *how* it shines. With a little leading the answer *when* might be obtained. Ask for a single word to tell *when*; *now*, or *to-day*.

Use other sentences in the same way, varying the tense:—

Father will come...*soon*. A great storm raged...*yesterday*.

I will come...*again*. The noise ceased...*immediately*.

From many examples deduce that these words tell *when* something is done, or when something happens.

5. Take another simple example, 'My brother stayed,' and ask for a word to be added to tell something else not *how* or *when* he stayed. Suppose the word *behind* given. What does this tell? *Where*. The boys ran...*away*. The duke lives...*there*.

Deduce that these words tell *where* something happens.

6. Taking the typical examples, which should appear on the blackboard, elicit that each of the words supplied to tell *how*, *when*, or *where* adds something to the meaning of the verb. They may form a single class of words. We call them *Adverbs*. The word *adverb* means a word added to a verb. When we add them we are said to modify the meaning of the verb.

7. Those adverbs that answer the question *How?* are called adverbs of *manner*; those that answer the question *When?* are adverbs of *time*; and those that answer the question *Where?* are adverbs of *place*.

8. Notice that many adverbs of manner end with *ly*. These are formed from adjectives. Guard children against calling all words with this termination adverbs. If formed from nouns they are usually adjectives, as 'He wore a *kingly* crown.' The same word may be either an adjective or an adverb, according to the purpose it serves. 'The newsboy *daily* brings the *daily* paper.' Daily is first an adverb then an adjective.

9. Notice that the place of adverbs in a simple sentence may be changed. '*Brightly* shines the sun *to-day*.' '*Heavily* hangs the tiger-lily.' 'The ploughman *homeward* plods his weary way.' '*Still* in thy right hand carry gentle peace.' "The people heard him *gladly*.'

10. Sum up the lesson. Words used to modify the meaning of verbs are called *adverbs*. There are adverbs of *manner*, of *time*, of *place*.

Other uses of the adverb and a complete definition should be reserved for future lessons. Exercises for the children to work should be carefully chosen, and not given by appointing a page of the reading book from which to pick out the adverbs.

2. Give some illustrations of the difference between compound and complex sentences.

Compound sentences are such as contain two or more independent statements, connected by such conjunctions as show them to be co-ordinate.

Complex sentences contain more than one statement; but while one is principal, the others, one or more, are subordinate or dependent.

The sentence 'The rain fell in torrents, and the river-courses were soon filled,' is a compound sentence; for the two statements connected by 'and' are co-ordinate and grammatically independent, though the fact stated in the second clause is a consequence of the fact stated in the first. If we make the latter of the two clauses grammatically dependent on the former we can turn the sentence into a complex one, thus 'The rain fell in torrents, so that the river-courses were soon filled;' the latter clause introduced by the subordinative conjunction 'that' is an adverbial clause denoting *consequence*.

'The train from out the castle drew,
But Marmion stopped to bid adieu.'

This is a compound sentence consisting of two co-ordinate clauses, the first occupying the first line, and the second being introduced by the conjunction *but*, which indicates the adversative relation, or a contrast between the two statements.

'Those are pearls that were his eyes,' is a complex sentence in which the last four words form an adjective clause attributive to the principal subject 'those.'

A compound sentence may contain subordinate clauses in addition to the co-ordinate principal sentences, and sometimes the co-ordinative conjunction is omitted. This sentence illustrates both these points—

'Old age ne'er cools the Douglas blood,
I thought to slay him where he stood.'

The clause 'where he stood' is adverbial, denoting place, and modifies the verb 'slay' in the previous clause.

Examples of compound sentences:

(*a*) 'Burned Marmion's swarthy cheek like fire,
And shook his very frame for ire.'

(*b*) 'With this his mandate he recalls,
And slowly seeks his castle halls.'

(*c*) 'To earth they sprang, their swords they drew,
And lifted high their shields, and flew
To win the narrow way.'

Four co-ordinate clauses.

(*d*) 'The ploughman homeward plods his weary way,
And leaves the world to darkness and to me.'

Examples of complex sentences:

(*a*) 'While there is life there is hope.'

(*b*) 'I hope your warrant will bear out the deed.'

The words after 'hope' form a noun clause, the object of 'hope.'

(*c*) 'I would to heaven I were your son, so you would love me.'

The principal clause is 'I would to heaven,' the other two are subordinate.

(*d*) 'If an angel should have come to me,
And told me Hubert would put out mine eyes
I would not have believed him.'

Of the four clauses in this sentence, all are subordinate but the last.

Examples of compoun dsentences with subordinate clauses in addition to principal ones.

(*a*) 'I sing to him that rests below,
And, since the grasses round me wave,
I take the grasses of the grave,
And make them pipes whereon to blow.'

Here there are three principal clauses, and three subordinate.

(*b*) 'Her feet bounded against the huge stone that stopped them, but she felt no pain.'

(*c*) 'We look before and after,
And pine for what is not.'

3. In what order would you teach the physical features of a country?

The first facts which should be taught about a country are its *boundaries* and *contour*, so that a clear notion may be formed of its position and shape. Next if it has a coast-line the character of that should be taught, and the names of *capes*, *inlets*, and neighbouring *islands*, if any. If it has no coast, the nature of its boundaries should be explained. Having taught what relates specially to shape or contour, I would call attention to its *surface*, teaching the names, position, and character of any *mountains*, *valleys* and *plains* in the country.

From this it would be a natural step to show how the *rivers* run, according to the distribution of the elevated ground. The connection of the mountains as *watersheds* with the river systems should be carefully traced.

Lastly, the *climate* and *natural productions* should be taught, and from a consideration of these, pupils should be taught to trace the character of the inhabitants and their industrial pursuits.

FOR TEACHERS IN INFANT SCHOOLS.

1. Write notes of a lesson on the Lion or Whale.

Lesson for class of children 6 or 7 years old.

Apparatus required, blackboard, sheet showing comparative sizes of animals, picture of lion, small toy model of cat, or picture of cat.

1. *Description.*—What do cats feed on? *mice*, *birds*. Animals that live on other animals are *beasts of prey*. There are many animals much like the cat. Ask a child to show some on picture. *Tiger*, *Leopard*, *Lion*. Which is the largest? *Lion*. Remember the Lion is the largest and strongest animal of the cat kind.

Give size of lion, 10 to 12 feet in length, show by comparing with objects in class-room. Strength, can knock a horse down with a blow of his paw, can carry an ox. Show how lion is like cat in its *teeth*, *tongue*, *paws*, *whiskers*, or feelers. The male lion has a long flowing *mane*, which is wanting in the female. The tail is tufted, and the skin covered with soft fur of a tawny or very light-brown colour. As many as possible of these facts should be elicited trom the children's observation of the pictures.

2. *Habits.* The lion lives in hot countries, in Africa and Asia, not in flocks, but usually in pairs, occupying a cave or den. Sleeps through the day, going long journeys at night to seek its prey, which it brings home for the *lioness* and *cubs* to share.

Show how its soft paws and its whiskers enable it to go about very quietly at night, how its great strength enables it to spring upon its prey, how its hooked claws can seize and hold the animals it lives on, and how with its teeth it can tear their flesh to pieces. It will take sheep and cows from farms, but will not attack man except in self defence, or when it is very hungry. Among the wild animals it pursues are deer, antelopes, goats, and giraffes. The African lion is the largest.

3. *Lion hunting.* Lions are hunted because they injure flocks and herds. Hunting them is attended with much danger. Several ways adopted. In one the hunters go on horseback, and have dogs, who track the lion to his home, rouse him from his day sleep, and are attacked by him. The hunters shoot him while he is attacking the dogs. Another more dangerous plan is to watch the lion when pursuing his prey, and aim at him with a rifle. Hunters have been often killed in this way, which is followed as a sort of sport. Tell anecdote of narrow escape of hunter.

Lion considered noblest of beasts, this chiefly on account of its appearance. Tell story of Androcles and lion, or fable of the Lion and Mouse.

2. Which of Froebel's gifts are intended to give the idea of form? How should they be used?

Froebel's gifts, numbered I. to VI., may all be used in giving elementary instruction in form. Gift I. consisting of six soft balls of different colours does not afford variety of form, nor the means of contrasting one shape with another. But the six balls may be compared with each other and with other objects of similar shape, and thus the idea of the sphere may be stored in the mind as the result of observation.

Gift II. including three solids in wood—the ball, the cube, and the cylinder—is well adapted for giving early notions of form. For not only may the solids themselves be contrasted with each other, and compared with familiar objects, but the surfaces of the cube provide us with squares, and the cylinder gives us also two circles, with which the surfaces of many common objects may be compared.

Gift III. is a cube of two inches divided into 8 cubes of one inch. Gift IV. is a similar cube divided into 8 oblong solids or bricks. Gift V. is a three inch cube divided into 39 pieces of which 21 are cubes of one inch, 6 triangular prisms made by halving 3 cubes of one inch, and 12 prisms made by dividing 3 cubes of one inch into quarters; and Gift VI. is a cube of 3 inches divided first into 27 oblong bricks, and 3 of these into 6 pillars or rectangular prisms and 6 into square tablets.

From this short description it will be seen that Gifts III. to VI. afford not only a considerable variety of forms in solids and surfaces, but also the means of making an almost infinite variety by combination. In using these gifts it should be borne in mind that the most valuable knowledge is that obtained from real observation. Hence the children should be encouraged to handle the gifts, to notice them carefully, to compare them with each other, and with such objects as they are familiar with in their homes and elsewhere. Thus they will readily notice for themselves the likeness of the ball to the balls they play with, or to the oranges they eat. Asked what is like a cube, they will mention a box, and what is like an oblong solid they will think of a brick. Then they should have the solids to put together, and by the aid of skilful superintendence they will become practically acquainted with many forms. In building up these forms the importance of accuracy in placing the solids and care in observing should be instilled; and it would be well to observe the rule of giving no name for a form until it appears that the idea is fairly grasped.

3. How may the ball-frame be used to teach the multiplication table?

The simplest idea of multiplication may be illustrated by taking one ball on the top wire of the ball-frame and one on the next, and showing that they count just the same as two on one line lower down; that is two ones are two. So we may proceed with two on the first, and two on the second line, and show that the two twos or twice two count the same as four on another line. This, if the ball-frame is of the kind having 12 rows of 12 in each row, may be continued to twice twelve equals 24. To impress it more thoroughly on the mind the teacher should then place two balls at the end of the first row, two at the end of the second, two at the end of the third and so on, until with these new combinations in succession the same point is reached.

A similar method may be adopted with the whole multiplication table up to 12 times 12. It should however be remembered that the multiplication table is only useful so far as it is kept in the memory. Therefore, when a part of it has been learnt by actual counting and observation, it should be required to be said from memory.

Music.

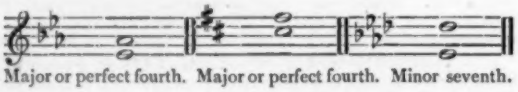
A Quarter of an Hour allowed for this paper.

(N.B.—Pupil teachers may answer the questions in either the Staff Notation or the Tonic Sol-fa, but *not both*.)

STAFF NOTATION.

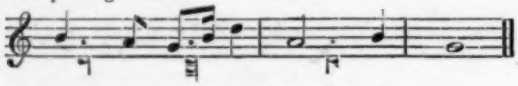
1. Write below each of the following intervals its name (minor third, &c.):

(1) (2) (3)



Major or perfect fourth. Major or perfect fourth. Minor seventh.

2. Write below the *dots* in the following the signs for *notes* of corresponding value:

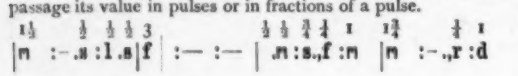


3. Explain (briefly) the meanings of the following terms:
   (1) Crotchet = M. 100.
   (2) Accelerando.
   (3) Crescendo.
   (4) Vivace.

(1) Rate of movement 100 crotchets in one minute. M. stands for Metronome, the instrument for regulating time in music.
(2) Increase rate of movement.
(3) Increasing force or loudness.
(4) Lively, quick.

TONIC SOL-FA NOTATION.

1. Write in figures over each note and rest in the following passage its value in pulses or in fractions of a pulse.



2. In which key will the following passage sound lowest: Key D, B♭, or A?

m s d t_1 r d

In Key D.

3. State (briefly) the meanings of the following:
   (1) M. 100 = Rate of movement 100 crotchets per minute. M. stands for Metronome, the instrument for regulating time in music.
   (2) Accelerando = Increasing speed or rate of movement.
   (3) Crescendo = Getting louder, increasing force.
   (4) Vivace = Lively, quick.

Recent Inspection Questions.

Arithmetic.

STANDARD I.

A.

(Sums dictated.)

1. 118 + 95 + 807 + 680 + 555. 2,255. Ans.
2. From 400 take 296. 104. Ans.
3. From 867 take 8. 859. Ans.

B.

1. 20 + 694 + 333 + 709 + 8. 1,764. Ans.
2. From 300 take 8. 292. Ans.
3. From 956 take 747. 209. Ans.

STANDARD II.

A.

(*Sums dictated.*)

1. From 84,016 take 5,608. 78,408. Ans.
2. Multiply 74,960 by 670. 50,223,200. Ans.
3. Divide 38,291 by 8. $4{,}786\frac{3}{8}$. Ans.

B.

1. From 150,090 take 49,001. 101,089. Ans.
2. Multiply 73,064 by 805. 58,816,520. Ans.
3. Divide 63,980 by 9. $7{,}108\frac{8}{9}$. Ans.

STANDARD III.

A.

1. How many times is 890 contained in 97,010?
   97,010 ÷ 890 = 109 times. Ans.

2. From seven thousand eight hundred and twelve pounds and a farthing take seven thousand six hundred and nineteen pounds and sixpence halfpenny.
   £7,812 0s. $0\frac{1}{4}$d. − £7,619 0s. $6\frac{1}{2}$d. = 192 19s. $5\frac{3}{4}$d. Ans.

3. Take the sum of £26 18s. 4d. and £3 17s. 6d. from £100.
   £100 − (£26 18s. 4d. + £3 17s 6d.)
   = £69 4s. 2d. Ans.

4. A shopman, instead of 13s. 9d. wrote £13 9s., and instead of 14s. $0\frac{1}{2}$d. put £14s. 10s. $0\frac{1}{2}$d.; find the amount of his errors.
   (£13 9s. 0d. + £14 10s. $0\frac{1}{2}$d.) − (13s. 9d. + 14s. $0\frac{1}{2}$d.)
   = £26 11s. 3d. Ans.

B.

1. Divide eight hundred and sixty thousand four hundred and eight by five hundred and sixty eight.
   $1514\frac{408}{568}$. Ans.

2. Add together £5,020 10s. 10d., £550 14s. 5¾d., £400,459 9s. 11d., £3,796 19s. 7½d., £11,086 16s. 4½d., £9,091 8s. 9¾d.

£430,006 0s. 0½d. Ans.

3. Find the difference between ninety-six pounds nineteen shillings and three farthings and eighty thousand one hundred and three pounds one shilling and five pence.

£80,103 1s. 5d. − £96 19s. 0¾d.

£80,006 2s. 4¼d. Ans.

4. After spending 16s. 8d. at one shop, £2 5s. 9½d. at another, and 37s. 5¼d. at a third, what had I left out of two five-pound notes?

£10 − (16s. 8d. + £2 5s. 9½d. + 37s. 5¼d.)

£5 0s. 1¼d. Ans.

STANDARD IV.

1. Reduce 716,800 poles to miles.

2240 miles. Ans.

2. How many farthings must be added to 1729 halfpence to make 20 guineas?

20 guineas = 10080 halfpence

10,080 − 1729 = 8351 halfpence.

= 16,702 farthings. Ans.

3. A farmer sells eight sheep at £4 7s. 6d. each, and nine pigs at £3 8s. 6d., and buys four cows. He finds he has £5 left. Find the price of each cow.

(£4 7s. 6d. × 8 + £3 8s. 6d. × 9 − £5) ÷ 4.

= £15 4s. 1½d. Ans.

4. £4824 9s. 11¼d. ÷ 95.

£50 15s. $8\frac{9}{19}$d. $\frac{7}{95}$f. Ans.

B.

1. £607 16s. 11¼d. × 89.

£54098 7s. 5¼d. Ans.

2. If £6080 14s. 7½d. be equally divided among 74 people what will be each person's share?

£82 3s. 5¼d. $1\frac{2}{74}$f. Ans.

3. How many hours are there in three weeks?

3 × 7 × 24 = 504 hours. Ans.

4. A man walked 17,010 yards while another walked 10 miles, by how many yards did one beat the other?

1760 × 10 − 17,010 = 590 yards. Ans.

STANDARD V.

A.

1. What is the rent of a field for a year if I pay £16 17s. 6d. for 4½ months.

4½ : 12 :: £16 17s. 6d. : £45. Ans.

2. 127 qrs. 3 bus. 3 pks. @ £6 15s. 6d. per qr.

£863 7s. 9¾d. Ans.

3. Add ⅔, ¾, and (⅚ − ⅕). $1\frac{11}{12}$. Ans.

4. A dealer bought 10 gross of eggs for £5. One gross were broken; the remainder he sells at a profit of 2s. 6d. Find the selling price per doz.

£5 2s. 6d. ÷ (12 ÷ 9) = 11 $\frac{7}{18}$d. Ans.

B.

1. Find by practice the cost of 763 yards of silk at 3s. 9½d. per yard. £144 13s. 0½d. Ans.

2. Make out a bill for—20 pairs of gloves @ 4½d. per pair, 9 thimbles @ 3¾d., 11 yds. of ribbon @ 10½d. per yd., 4 pairs of boots at 8s. 9d., 192 yds. of tape @ 4½d.

(7/6 + 2/9¾ + 9/7½ + 35/0 + 72/0).

= £6 6s. 11¼d. Ans.

3. A woman could make 36 collars in 19 hours, how long would she work to make 288?

36 : 288 :: 19 hours : 152 hours. Ans.

4. If ⅓ of a girl's age was taken from ¼ of 48, it would leave 7: what was her age?

¼ of 48 = 12. 12 − 7 = 5 = ⅓ of girl's age.

∴ 15 = girl's age. Ans.

STANDARD VI.

1. 1⅓ of 4·7d. + 2·35 of 1s. + ·2375 of £1, and reduce to the decimal of 7/6.

$$\frac{1\frac{1}{3} \text{ of } 4{\cdot}7\text{d.} + 2{\cdot}35\text{s.} + {\cdot}2375\text{£}}{7/6} = 1{\cdot}025. \text{ Ans.}$$

2. Required the simple interest on £215 2s. 6d for 3 years 73 days at 4½ per cent. per annum.

£30 1s. 0d. Ans.

3. A post is standing in a river, ⅓ of its whole length is in the mud, $\frac{3}{10}$ in the water, and the remainder, 7½ feet, in the air. Find the depth of water.

$1 - (\frac{1}{3} + \frac{3}{10}) = \frac{1}{2}$

$\frac{1}{2}$ pole = 7½ feet

∴ $\frac{3}{10}$ pole = 4½ feet. Ans.

4. £1250 is invested for 2½ years at 4 per cent. The amount thus realized is invested in the purchase of land at £75 per acre. How much land is bought, allowing £25 for the expense of purchase.

$$\text{Int.} = \frac{£1250 \times 2\frac{1}{2} \times 4}{100} = £125.$$

(£1250 + £125 − £25) ÷ 75 = 18 acres.

B.

1. If $\frac{8}{7}$ of ¼ of an estate be worth £90, what is the value of the whole?

$\frac{8}{7} \times \frac{1}{4} : 1 :: £90 : £420.$ Ans.

2. Find one half year's simple interest on £72·625 at 3½ per cent. per annum. Give the answer in £ s. d. £1 5s. $5\frac{1}{10}$d. Ans.

3. Find the value of $\frac{\frac{1}{4}(\frac{1}{2\frac{1}{4}} - \frac{1}{3\frac{1}{3}})}{\frac{1}{4}(\frac{1}{2\frac{1}{4}} + \frac{1}{3\frac{1}{3}})}$ of $6\frac{3}{7} \div 2\frac{1}{4}$.

$\frac{4}{7}$. Ans.

4. What sum of money bears the same ratio to £1 18s. 6d. that 6 bears to 7?

7 : 6 :: £1 18s. 6d. : £1 13s. 0d. Ans.

STANDARD VII.

1. By selling 52 yards at 3s. 4½d. per yard a draper gains 8 per cent., what was his whole gain on the 52 yards?

108 : 100 :: 3s. 4½d. : 3s. 1½d. Cost price.

3d. × 52 = 156d. = 13s. Ans.

2. If a tradesman with a capital of £2,000 gain £50 in 3 months, what sum will he gain with a capital of £3,000 in 7 months?

2,000 : 3,000 :: 50 : £175. Ans.

3 : 7

3. Average the following numbers: 28, 1·9, 63, 73, 19·5, 4·8, 15.

29·3142857. Ans.

4. If a grocer mixes 17lbs. of tea worth 4s. per lb. with 25lbs. worth 4s. 8d. per lb., and sells the whole at 5s. 4d. per lb., what does he gain per cent.?

184⅔ : 100 :: 39⅓ : 21 $\frac{63}{177}$. Ans.

Dictation.

STANDARD I.

A.

Baby, until, girl, floor, jump, picture, bushes, ground, wings, clear.

B.

Catch, bread, knee, pussy, useful, spend, night, dead, gently, linger.

STANDARD II.

If he is near a village, the dogs bark, and the horses, oxen and camels rush about in terror; for they know not the voice of the lion. The men light fires all around, and toss about flaming torches to scare him away.

STANDARD III.

In a moment he knew that the wild nature of the animal had awakened, and that if he withdrew his hand the tiger would at once spring upon him. Calling to his servant, whom he saw at a little distance, he told him to fetch a loaded gun and shoot the tiger dead on the spot.

STANDARD IV.

Birds, beasts, and insects live there, for the most part undisturbed. It is their home; and on every side they are at work, hunting their prey or escaping from danger. For though man seldom wages war upon them, these wild creatures of the forest are engaged in constant warfare with each other, and the weak are always using some contrivance to protect themselves from the strong.

STANDARD V.

A.

We wake after a night's repose and find ourselves conducted on our voyage one hundred miles, we exult in the triumphs of art which has moved the ponderous vessel so swiftly and yet so quietly as not to disturb our slumbers. But with a motion vastly more quiet and uniform we have in the same time been carried with the earth over a distance of more than half of a million of miles.

B.

A short story written from memory after being read over twice.

Composition.

STANDARD VI.

A journey in a railway train, or 'Feathers.'

Grammar.

STANDARD IV.

A.

He called on me the very next morning.

B.

The leaves of the forest were already beginning to fall.

STANDARD V.

A.

Parse the words in italics:—To *seek thee did* I *often walk* through the *wood*. Analyse the sentence.

Form nouns from *commence*, *begin*, *hill*, *dark*, and *rich*.

B.

Parse the words in italics:—The *little crew*, *promising* to *make* the *case* of their comrades *known*, then set sail. Analyse the sentence.

Form verbs from joy, slave, dark, glorious, and ruminant.

STANDARD VI.

Parse the words in italics, and analyse the whole sentence:—*As* I *had no other* boy *near* me to *play with* I threw *them till* I became *very* accurate in *my aim*.

Give the meanings of the following prefixes and examples of their use:—Ex, e, extra, im, per, trans.

——o——

Messrs. LONGMANS are about to publish Part First of a new and enlarged edition of Professor Bain's Rhetoric and Composition. In this edition the author proposes to omit a number of the topics comprised in the existing work, and to bestow a greatly expanded treatment upon points selected on account of their importance, as well as their suitability to pupils of a certain standing. In Part First the subjects are:—Order of Words, Number of Words, the Sentence, the Paragraph, Figures of Speech, and Intellectual Qualities of Style. The Second Part, which will speedily follow, is exclusively devoted to the Emotional Qualities of Style, and is meant to be an introduction to the higher criticism of poetical literature. The First Part will be accompanied by a small volume, entitled 'On Teaching English,' which is partly controversial and partly didactic. It discusses the various methods of English Teaching at present in use, and exemplifies the Rhetorical method in a series of select lessons. It also handles, at some length, the vexed question of the definition of Poetry.

A HAPPY NEW YEAR.

Cheerfully. Music by T. CRAMPTON.

TREBLE. ALTO. TENOR. BASS.

f

1. Ring the bells mer - ri - ly, ring loud and long! Hail to the dawn - ing of
2. Ring the bells mer - ri - ly, wel - come to all! Shout! till the e - cho takes
3. Tell it to moun-tains that reach to the sky! Tell it to fo - rests that

KEY E. *Cheerfully.*

TREBLE.	d'	:- .t	:l	|s	:- .f	:m	f	:r	:s	|m	:—	:	d'	:- .t	:l	|s	:f	:m
ALTO.	m	:- .s	:f	|m	:- .r	:d	r	:t$_1$	:t$_1$	|d	:—	:	m	:- .s	:f	|m	:r	:d
TENOR.	d'	:- .d'	:d'	|d'	:- .s	:s	l	:s	:s	|s	:—	:	d'	:- .d'	:d'	|d'	:s	:s
BASS.	d	:- .d	:d	|d	:- .d	:d	f$_1$	:s$_1$	:s$_1$	|d	:—	:	d	:- .d	:d	|d	:t$_1$	:d

New Year's bright morn! Lift up your voi - ces high, sing loud and clear;
up the glad call; Breathe it to moor - land, to mea - dow, and hill,
send back the cry; Sing till all na - ture takes up the glad strain, And

	f	:r	:s	|d	:—	:	m	:m	:s	|d'	:- .t	:l	s	:m	:l	|r	:—	:
	r	:t$_1$	:t$_1$	|d	:—	:	d	:d	:r	|d	:- .d	:d	d	:d	:d	|t$_1$	:—	:
	l	:s	:s	|m	:—	:	s	:s	:s	|m	:- .m	:f	m	:s	:f	|r	:—	:
	f$_1$	:s$_1$	:s$_1$	|d	:—	:	d	:d	:t$_1$	|l$_1$	:- .s$_1$	:f$_1$	d	:d	:f$_1$	|s$_1$	:—	:

f CHORUS.

Join in the cho - rus, "A Hap - py New Year!"
Whis - per it gent - ly to ri - ver and rill.
shout "Hap - py New Year!" a - gain and a - gain.

"A Hap - py New Year!" "A

mf

f CHORUS. *mf*

	m	:m	:s	|r'	:- .d'	:t	d'	:t	:l	|s	:—		s	s	:r'	:t	|d'	:— :
	d	:d	:r	|r	:- .r	:r	m	:r	:d	|t$_1$	:—		r	r	:f	:r	|m	:— :
	s	:s	:s	|fe	:- .fe	:s	m	:s	:fe	|s	:—		t	t	:t	:s	|s	:— :
	d	:d	:t$_1$	|l$_1$	:- .l$_1$	:s$_1$	d	:r	:r	|s	:—		s$_1$	s$_1$	:s$_1$	:s$_1$	|d	:— :s

ff

Hap - py New Year!" Join in the cho - rus, "A Hap - py New Year!"

		:	:	|	:	:	*ff* s	:s	:s	|d'	:s	:d'	t	:- .l	:t	|d'	:—	:
		:	:	|	:	:	m	:m	:m	|d	:d	:d	f	:- .f	:f	|m	:—	:
		:	:	|	:	:	s	:s	:s	|s	:s	:s	s	:- .s	:s	|s	:—	:
	m	:r	:d	|s	:—	:	d	:d	:d	|m	:m	:m	s	:- .s	:s	|d	:—	:

A Drawing Examination in an Elementary Day School under the New Class Subject Regulations.

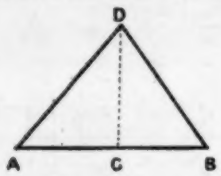
1. The following particulars were required of all:
(*a*) Name of school.
(*b*) Child's name, age, and standard.
(*c*) Number of copy, if any, used.

STANDARD I.

The children in this standard were required to draw on their slates only.

(*a*) They were ordered to draw a line from left to right across the middle of the slate.

(*b*) The teacher of the class was then told to draw an isosceles triangle on the upper half of the black board. This exercise was done in the following way:



(1) The teacher drew the line AB.

(2) A boy was asked to come forward and mark a point, C, midway between A and B.

(3) Another boy was told to draw an upright line from C to D, and then from D to draw lines DA and DB.

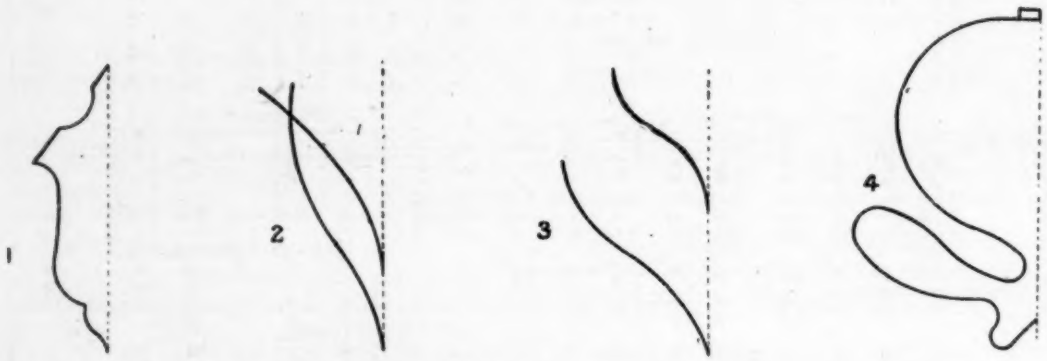
When the copy was completed on the board, the class was told to draw the same on the upper half of their slates by freehand.

After sufficient time had been allowed for this exercise, the class was ordered to draw the same figure by the aid of their rulers on the lower half of their slates.

STANDARD II.

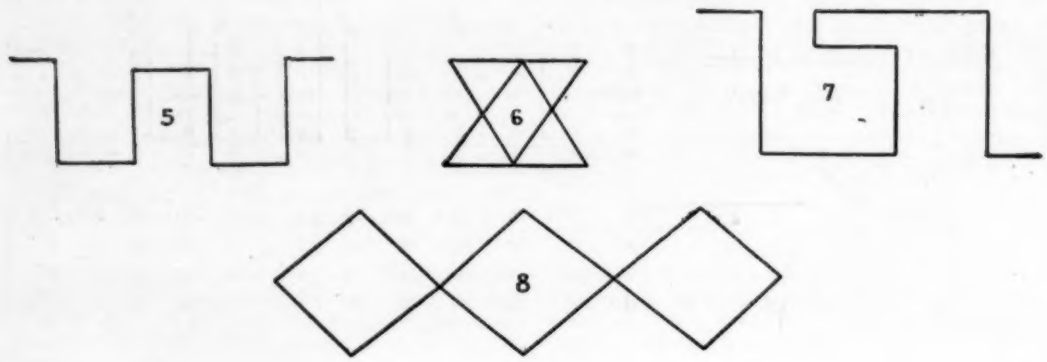
This standard had the same exercise as Standard I., the only difference being that in the case of Standard II. the work was on paper.

STANDARD III.



N.B.—(1) The whole copy was given in all the above cases.

(2) Exercises 1, 2, 3, 4 were drawn on separate copies supplied by the department, and all were to be drawn by freehand.



(3) Copies 5 and 6 were drawn on one paper by the aid of rulers.

Similarly copies numbered 7, 8.

(4) The exercises numbered respectively 1, 2, 3, 4 (5 and 6) and (7 and 8) were given to different children in the order in which they sat, so that no boy had two copies, and no two boys sitting together had the same copy.

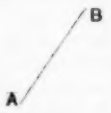
STANDARD IV.

1. *MODEL DRAWING.*

A hexagonal prism standing on its end.

2. *GEOMETRY.*

(*a*) Draw a line parallel to the given line AB, one inch from it.



(*b*) Construct an equilateral triangle with sides 2″ long.

(*c*) From a point A, describe another circle with the same radius as that of a given circle, to touch it.

(*d*) Draw a right angle and divide it into four equal angles.

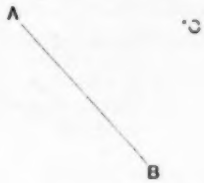
(*e*) Draw two circles, one 1″ radius, the other ½″ radius, to touch one another on the outside.

(*f*) Divide AB into six equal parts.

(*g*) Draw an isosceles triangle, base 2¼″, angles at base 45°.

(*h*) Construct angle of 60° and bisect it.

(*i*) On a copy is the given line and the point C. From the point C draw a line perpendicular to the given line AB.

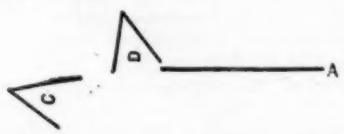


(*j*) Upon a base of 2″ construct an isosceles triangle, the angle opposite the base to be 45°.

(*k*) Construct a triangle with base 2″, the angles 60°, 45°, 75° respectively.

(*l*) Construct a square of 2″ sides.

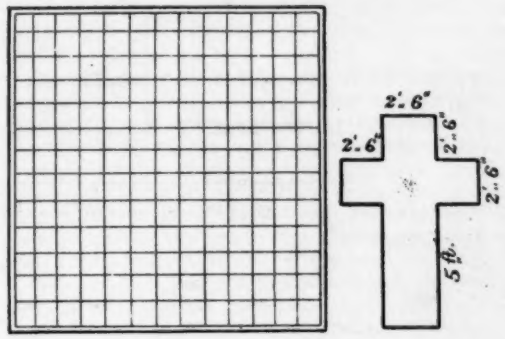
(*m*) With given angles C and D, construct a triangle upon the base line *a*.



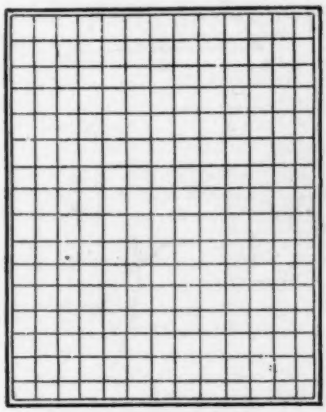
(*n*) Through the point C, draw a line parallel to a given line AB.

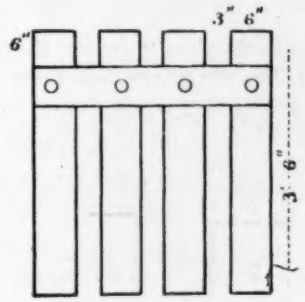
3. *DRAWING TO SCALE.*

(*a*) A copy showing front view of an envelope, size 1″ × 2″. Draw it three times the size.



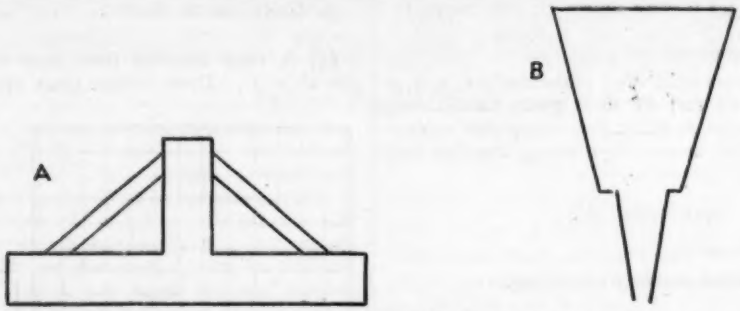
(*b*) Cross with measurements as given above: Draw on the squared paper, each side of square representing 1′.





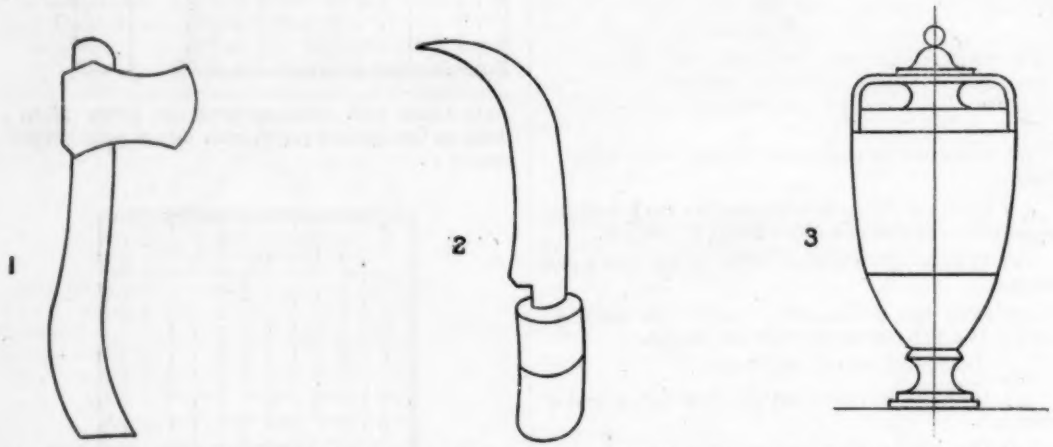
(*c*) Fence, with dimensions as in the figure, to be drawn on the squared paper, each square representing 3″.

(*d*) Draw a magic lantern, measurements of which were given on the figure as above. The scale of square representing 1″.



(*e*) Each of the figures A and B to be drawn twice the size.

4. *FREEHAND.*



The above were all small copies. 1 was to be drawn smaller than the copy; 2 and 3 were each to be drawn larger than the copy.

STANDARD V.

1. *MODEL:—*

A toilet jug.

2. *GEOMETRY:—*

(*a*) Elevation of cube given. Copy it and draw its plan.

(*b*) Plan of cube given to draw its elevation.

(*c*) Draw two lines vertical to H.P. and draw their plans.

(*d*) Given figure was a plan of a right prism standing on its base on the H.P. Its altitude is 2″. Draw its plan and elevation.

(*e*) Plan of rectangular solid given at angle of 30° to V.P. Copy it, and draw the elevation. Base is a square.

(*f*) Plan of a rectangular prism at 30° to the H.P., standing on long side. Draw the elevation and copy plan.

Lines and points were also given. Required, the plan, or elevation, or both.

3. *FREEHAND:—*

(1) A large copy was pinned on a black board. The copy represented an oak leaf with stem.

N.B.—Large copies were pinned on the board for other standards.

(2) A smaller copy representing an oil vessel with many parallel curved lines.

(3) Draw the accompanying figure:

Enlarge the drawing.
The whole of this copy was given.

4. *SCALE DRAWING:—*

Scale of $2\frac{1}{2}$″ to a foot given.
Required to measure off on it, 3 ft. 1 in.

How to teach the Babies.

BY JAMES BAILEY.

Head Master of Southlands Training College.

CHAPTER VI.

'ORAL LESSONS.'

HAVING set before ourselves the general principles involved in the management and instruction of young children, let us consider their practical application to the usual subjects of class teaching. We begin with that large class of subjects which are taught solely by the teacher in the form of 'oral lessons.' The method of these lessons, as distinct from that employed in the teaching of what are officially described as 'Elementary Subjects,' has been already detailed at considerable length, and what has been advanced on this matter may be thus summarized:

The matter of these lessons should be as completely as possible the outcome of the teacher's own knowledge of the subject, and the subjects themselves should very largely consist of things which come commonly within the scope of the children's observation or which admit of visible illustration by pictures and diagrams.

Each lesson should present a few short, simple, definite points of instruction:

These to be arranged in clear logical sequence, one part depending on and growing naturally out of the preceding part:

The language to be simple, good, and easily understood by the children, and the method thoroughly conversational.

Every part of the lesson which admits of it to be simply and clearly illustrated; the things shown to be handled and acted upon by the children themselves so far as the nature of the subject and the illustration admit of it.

While the observation of the children is thus well exercised their memory and imagination are to be gently excited by judicious questioning, and by animated and picturesque description.

The manner of the teacher is to be winsome, sympathetic, sensible.

The tender susceptibilities of the little ones, physical and moral, are to be duly cared for.

In this connection some excellent suggestions are given in the 'Instructions to Teachers' of infant schools, issued by the School Management Department of the School Board for London.

Quoting from a document issued by the Education Department, it is observed, 'The aim of these lessons should be:

"To develop in the children's minds an interest in the things around and about them; to teach the use of all the senses, and from habits of observation to impart a correct knowledge of common things; to increase the infants' vocabulary and power of expressing themselves."'

The paper then goes on to say, 'In order to carry this out it will be necessary to talk with the children about the objects around them in such a way as to draw out their own powers of perception and thought. The objects thus conversed about should not be many in number, and should, if possible, be the real things themselves; if that is impossible, models should be used, or correctly coloured pictures. The objects should be in sufficiently large quantities to be inspected, handled, and, perhaps, tasted, and smelt by each child, and their several parts should be pointed out and named, with their more simple qualities and uses.'

'The lessons in the earliest stage should at first be based on the facts of home life which are within the observation and knowledge of the "babies." The baby room should, therefore, be made as nearly as possible like the home, and should contain familiar household objects, or, at least, pictures of them. The lessons should be conversational, and the teacher should suggest and guide the conversation rather than monopolise it.'

Welcome indeed is the change by which, after long years of comparative neglect, recent regulations of the code have assigned 'simple lessons on objects, and on the phenomena of nature, and of common life' to their proper place of importance in the routine of infant school work. But before dealing further with them, something must be said of that which stands first in importance in all educational training, viz., Scripture instruction. Valuable, nay essential as are oral secular lessons, the infant school Bible lesson occupies still higher ground.

A well-conducted Bible lesson is, even in its lowest aspects, a mental exercise of the highest value. In no other lesson throughout the day is there combined in the same proportion the interest and the profit arising from the free play of the intellectual and the moral faculties. Its narratives and incidents appeal strongly to the imagination and the sympathies of little children, even the youngest. Then, too, Scripture instruction forms the only sure basis of good moral conduct. I know, of course, that this special part of our work finds no place among the recognised Code subjects. In order to meet the exigencies of a State system of instruction, towards the payment for which all citizens must contribute, whatever their opinions may be as to the necessity or expediency of Bible teaching, such teaching must be entirely separated from secular instruction, which is the only part recognised in the inspection and paid for by the Education Department.

Happily the scope of these papers does not admit us into the uninviting regions of controversy on this topic, neither as to whether religious instruction shall be given, nor, by whom. We contemplate no such dreary programme as would be followed in a school-day's work out of which the morning Bible lesson is left, or in which no place is found for the learning and singing of suitable hymns, with simple exposition of their meaning, or in joining together, teachers and taught, in the worship, by praise and prayer, of the Common Father.

The subjects found most suitable for Scripture lessons for young children are those taken for the most part, though not exclusively, from the biographical and narrative parts of the Bible. The method is, that blending of pictorial verbal description with free conversation, by means of questions and ellipses, which has been set forth as the fitting medium of intercourse between the teacher and her young charge. Both worship and instruction will, of course, be

reverent, natural, and *real*, and the simple lessons deduced from the teaching will be such as may be applied naturally and lovingly to the guidance and help of a child's life.

Reference has already been made to the recent fuller and more satisfactory recognition of the true province of the infant school, both as to subjects and methods, than has for many previous years been accorded to it in the regulations of the Department, and the requirements of H. M. Inspectors. This is but a return in some measure to the methods and processes of such educators as Pestalozzi and Froebel on the Continent, and Wilderspin, and, much more emphatically, David Stow, in Great Britain. These have been well set forth, too, not only in the published works of the persons named, but in other books of school management and method from time to time, notably in Mr. Currie's 'Early and Infant School Education.'

Some useful guidance is afforded us as to what to teach, in the 'Instructions' issued to H. M. Inspectors. It is required that lessons should be given 'on animals; on such subjects as coal, glass, and salt; on common employments, as paper making, cotton mill, house-building; on form and colour, food, plants, and clothing; on simple facts in nature, as rain, frost, the seasons; on familiar scenes in common life, as the post office, a shop, a railway, washing, or harvest.' It is also required that these lessons should be frequently and suitably *revised*. It is a serious and by no means a rare error to go on day after day giving fresh lessons, presenting new stores of information which, for want of well-conducted, systematic revision, buries out of sight and out of mind, what has gone before it, and which, in turn, is itself speedily buried and forgotten under the accumulation of successive deposits.

Lessons of revision may be made as interesting as they are useful. The method should be chiefly interrogative, the questions following each other easily, and naturally so as to cover, and to recapitulate, the whole ground of the previous teaching; especially should the principal facts and inferences be summarized in short, simple, definite sentences to be repeated by the children till they are fairly well known.

It is well to group together for purposes of revision, several similar and related lessons. Thus, the pictures of several animals on which lessons have been given, or the objects on which several lessons have been based, may be presented together to the class, and questions on each of them in succession be asked. It may be pleasantly varied too, by bringing out and placing before the class, one or more of the children who should be questioned by their class-fellows, their places being taken by those whose questions they cannot answer. Or they may in turn question the class. This is a good training in language, and in power of expression. Imperfect answers should be corrected and completed, and nothing slipshod or vulgar be allowed.

The lessons under consideration may be grouped thus: *Animal Life*, *Vegetable Life*, *Common Objects*, *Natural Phenomena*, *Common*, or *Social Life*, *Miscellaneous Lessons*. Without being too rigidly arranged it is yet well that the several series of lessons should have some relation to each other, so as to accustom the children to observe the connection which exists between many of the various things around them. Thus, lessons on clothing, or on foods, should alternate with lessons on animals and plants which furnish materials from which the clothing is made, or the food obtained. Again, good *typical* subjects should be chosen, the knowledge of whose qualities and properties will suggest similar knowledge of other things more or less like them, as when the cat is made to represent the class of beasts of prey formed like her; the rabbit, of gnawing animals; the duck, of wading birds; gold or iron of metals, and the like; also such animals as strike the imagination and excite the interest of children, because of peculiarity of structure, or mode of life.

Further, where this kind of lesson is frequent, as with little children it should be, it may be desirable to assign special classes of lessons to special days of the week. Thus, on Monday, an animal; on Tuesday, an object; on Wednesday, a vegetable; on Thursday, some fact of nature (natural phenomena); Friday, a trade, or topic of social life, or a miscellaneous subject. This will insure a pleasant variety, and will prevent both the neglect of any proper class of subject, and too continuous attention to others. Lists of such lessons, serving say, for a quarter of a year, should be carefully arranged. They may follow some such order as the following:—

Monday.—Object Lessons: A chair; a glass of water; a loaf of bread; a cup and saucer; paper; salt; an apple; a penny; milk; a brick; glass: a lesson of revision.

Tuesday.—An Animal (or living things): The cat; the hen; a herring; the butterfly; the sheep; a robin; the crab; the bee; the lion; the eagle; the shark; the spider; a lesson of revision.

Wednesday.—Plants, or *Plant Life:* The oak; the daisy: the rosebush; grass; wild flowers; the ivy; the palm tree; water plants; the grape tree; uses of trees; how seeds grow; a lesson of revision.

Thursday: Rain; the clouds; a river; the sea-shore; winds; snow; ice; a summer day; a winter day; rocks and stones; the sun; a lesson of revision.

Friday: A grocer's shop; a railway train; a carpenter's shop; housebuilding; a harvest field; a farm-yard; a blacksmith's shop; description of a ship; catching fish; a market place; the postman; a lesson of revision.

(To be continued.)

—o—

Typical Schools which I have Examined.

By an Inspector of Schools.

—o—

I NOW proceed to give particulars of a couple of schools in a large northern town, noted both for the excellence and the novelty of their methods. They are both boys' schools. The first of these derived great benefit from an Honour Board, an institution to be met with in some of our public schools. This board had entered upon it in gold letters the names of all the boys who have passed the Sixth Standard in three subjects, and has served as a considerable stimulus to the scholars in the upper part of the school; indeed, the desire to distinguish themselves in

the highest class of the school keeps many a lad at school a year or two longer than he would have otherwise have been disposed to stay—with the very best result upon the boy's ultimate prospects. This school is in a low quarter, and consequently is not able to retain its scholars in the upper standards to the same extent as others attended by a better class of boys. The following Table for a period of four years exhibits the improvement effected in the number of scholars in the Upper Standards.

	Year ending Nov. 18—	Year ending Nov. 18—	Year ending Nov. 18—	Year ending Nov. 18—
Standard I. ...	68	59	58	53
„ II. ...	55	69	68	92
„ III. ...	36	47	51	75
„ IV. ...	34	32	37	64
„ V. ...	14	21	21	41
„ VI. ...	3	7	12	16
„ VII. ...	1	2	5	9
Totals ...	211	237	252	350

In the Girls' Department of this School there were also several special features.

The girls were taught needlework with great ability, care, and success, and much more pains was taken than is at all usual with cutting out in the upper Standards. To the best of my belief simultaneous lessons were given in the first instance by means of paper patterns, and only when the paper could be readily and thoroughly dealt with did the mistress proceed to deal with clothing materials. As soon as a girl had reached the Sixth Standard she was promised a good dress on condition of her cutting it out and making it, and I had the satisfaction from year to year of seeing all the girls in this Standard dressed on the examination day in well-fitting and graceful dresses of their own handiwork. Many of these girls were the daughters of factory hands. The wife of the leading lay manager took the heartiest interest in this school, visiting it frequently, and taking pains to commend the girls for neatness of personal appearance, just as much as for proficiency in their studies. She told me, when I expressed astonishment at the unusually neat and yet simple way in which the girls' hair was always dressed, that the secret of this was the fact that having noticed a couple of years before that many of the girls were exceedingly careless in this very respect, it had occurred to her to offer a small mirror to those girls in the upper Standard who took special pains with their hair for the future. Of course no fringes were allowed, and the extremity of the fashion was not followed. The result had more than justified her anticipations, and had, as I have stated, aroused my astonishment. I should add that the girls were given examination ribbons for their hair, care being taken that they suited the wearer. The room was always dressed in exquisite taste, flowers always being abundant, not only for the inspection, but for what was to follow it. And this was—1st, a gathering of the parents to see the prizes distributed to their children; 2nd, a school supper, to which all the managers and the teachers of three very large departments, numbering about 1,000 scholars, sat down together, and to which, as the entertainment was of the best, I need hardly say they did ample justice.

Much of the success of this school is due to the establishment in it of the merit card system. A cheap coloured card, on the back of which the date and the scholar's name are entered, is given to each boy, girl, or infant who has been present early during each of the ten attendances possible in the week. When a child has gained twelve of these tickets, he is entitled to a small prize, valued at 3d. in the lower standards, and from 4d. to 6d. in the upper ones. The following extract from a letter written by the master well explains the advantages of this system: 'The enclosed will enable you to form a correct opinion of the success which the merit card system has attained since its introduction into these schools.

'I am strongly of opinion that a large measure of this success is attributable to the constant personal attention bestowed by Mr. and Mrs. ——— upon the carrying out of the plans laid down. I mentioned in my last communication to you that the tickets and rewards are in no case distributed by the teachers. One or more of the managers always discharge this very important duty. I will, with your permission, briefly state what the special advantages of this mode of procedure are: 1st. It is an effective check upon careless registration, on the part of young teachers especially, for the slightest error is brought by the children themselves under the notice of the manager who may be at the time giving the rewards. Thus a very important habit is gradually formed by pupil teachers intrusted with the marking of registers which will in after life always assert itself under increased responsibilities.

'2. It brings the children constantly in contact with at least one gentleman or lady visitor, the desire to please whom gradually, yet surely, leads them to the performance of many duties which have an important bearing on the formation of character.

'The first of these is punctuality of attendance.

'2nd. Cleanliness. A particularly clean boy is commended, while a slovenly boy coming for his ticket or reward is kindly admonished.

'3rd. It encourages truthfulness. A boy may have his name accidentally on the list of recipients when he is not entitled to a reward. Very rarely indeed has a boy been found to accept a ticket under such circumstances. The word of praise and encouragement given by the manager on such occasions has an effect which cannot be immediately measured.

'4th. It makes the roughest boy more respectful. Very seldom now has a boy to be reminded that his thanks, properly expressed, are due to those who take so deep an interest in his welfare.

'The happy, eager expressions stamped on every boy's face on seeing the supporters of the school come into the room where they are, is an auspicious omen for improved social relations in the future. It will be a hard task for any demagogue, paid or otherwise, to convince the lads who pass through these schools that the classes above them are their natural enemies.'

The following memorandum has a pathetic interest as showing upon what the success of the Lower Mosley Street School, Manchester, was based when under charge of the writer, that remarkable teacher,

George Smith. It has been published previously but only in an appendix to a work now, we believe, out of print, and then entirely escaped the notice of the reviewers.

A.—Regulations as to Pupil Teachers, &c., in Public Elementary Schools.

Pupil Teachers.—We meet each morning at 8.15, and the time until 9 o'clock is spent in the repetition of lessons prepared at home on the previous evening. The home lessons consist of two parts, a 'learning lesson' and a 'writing lesson.' The questions proposed to be answered are prepared on the Saturdays by the master, and entered into a book, 'The Question Book,' so that on Monday morning the pupil teachers copy their week's work.

Each pupil teacher receives marks for his lessons, which are registered in a book kept by the senior pupil teacher. At the end of every quarter the teachers receive, in addition to their salaries, a small amount of pocket money. Any negligence or carelessness in the preparation of home work causes some slight deductions to be made. The teacher feels it a degradation to have even a few pence withheld.

At noon, from 1.10 to 2, the pupil teachers receive direct instruction as a class. On Monday, singing; Tuesday, analysis and parsing, and algebra; Wednesday, French; Thursday, algebra and mensuration; Friday, reading, talks on school management. All these lessons at noon are very pleasant and very profitable. The pupil teachers are anxious to get a good mark for their work, and thus an earnest, honest effort is produced.

Scholars.—In addition to the medals which are used in most lessons, and which cause all pupils to have an equal interest in the lessons, we have also a system of marks. In every lesson a boy can get six marks for excellent work; and, if neatness be also involved, he may gain an additional six for neatness. The marks thus gained are registered by the boys at the end of every lesson, and the teacher enters the total at the end of the day.

On Friday afternoon, in the presence of the whole assembled school, the names of six of the highest boys in each class are called out by the master, and comments made upon the merits of their work. No other prize is given, and it is extremely gratifying to find how pleased and delighted a boy is who has had the honourable distinction of hearing his name called out. This simple plan has been very beneficial in calling forth a spirit of emulation.

Rules for the Guidance of Pupil Teachers and Monitors.

1. You must be at school at 8.15 in the morning, and 1.15 in the afternoon.

2. Every lesson must be carefully and thoughtfully prepared.

3. You must have your books, slates, &c., in their places at the required time.

4. You must take care of any of the school apparatus placed under your charge.

5. You must be very diligent in the conduct of your class, speak in a gentle tone of voice, follow out the plans laid down for your guidance, and seek to realise higher results.

6. You must have a note book for class use, in which a daily register is kept of your class work, and the names of the pupils requiring special attention.

7. You must have a note book for use in your own private studies.

8. Always act in a gentlemanly manner towards each other, and never leave school in the evening without first seeing the master.

9. Playing in the schoolroom at any time is strictly prohibited.

10. Fines will be imposed for the neglect of any of these rules.

'What is worth doing, do well.'

To encourage early attendance, every pupil who is at school punctually at 9 and 12 receives a red ink mark in the register.

B.—Rules as to Teaching, &c.

As the children enter the school in the morning, they place their home lesson books on the desk arranged to receive them.

They are examined by boys chosen from the first class at 9.30, they are again distributed to the pupils, and then they are looked at by the master to ascertain whether they are neatly and accurately done. All the neat books are held up before the class, and comments made upon them.

The boys are much pleased to have their books shown, and it is frequently a great incentive to the careless and indifferent ones.

Reading.—To secure attention in the junior classes, each child is provided with a pointer, and he is required to point to and say silently every word that the child before the class is reading aloud. To gain boldness of expression and clearness of utterance the child who reads aloud stands upon a form in front of the class. Should he make a mistake hands will be raised and the correction made by a child, who passes up in his class.

The teacher is required to know the lesson that the children are about to read, and it is his duty to tell in his own words the substance of the lesson read. The pupils then read with more intelligence, because they have some general knowledge of the subject matter.

Words wrongly pronounced during the lesson are written on the blackboard, and carefully said, first by the teacher, and then simultaneouly by the scholars.

A few minutes of quick questioning upon the subject matter occurs at the end of the lesson.

I should like to see reading books prepared with a little more attention to good and suitable literary extracts and a little less of the dry scientific information. A book containing a number of biographical sketches of men who have risen from the ranks or who have distinguished themselves in the pursuit of knowledge under difficulties is a desideratum. I am quite sure that it would be a moral lever in school life.

Arithmetic.—In introducing the children to a new rule explanations are given, and many examples are worked on the black board until the children are familiar with the processes, and are quick in the manipulation of the figures. Then the problems are read from the arithmetic used in the class, and by questioning they are worked round the class, the pupils putting

the figures upon their slates whilst the teacher does the same on the black board. Then we have frequent examinations to test the ability of the children.

Dictation.—This lesson only tests the ability of the children in spelling, and it should never take the place of oral spelling. Most of our dictation lessons are therefore carefully prepared. The difficult words are spelled in the class and written upon the board by the teacher. This occurs immediately after the reading lesson, and the dictation may take place at the next meeting of the school. If any difficulty occurs during the dictation of the passage I do not hesitate to have the word spelled, and even written on the board. In many irregular words, it is only repetition that confirms the children in the correct method of spelling.

To make the boys familiar with words other than those generally found in their reading books, nine different words taken from the classified list in Davis's spelling books are given each day to learn at home.

Geography.—Two classes forming a section of the school are always joined together for geography lesson. A portion of their text book is set for them to learn. This is repeated by several, chosen at random, and questions asked on the additional information supplied during the last lesson. Then, a lesson carefully prepared by the teacher is given, in which much interesting information is conveyed.

In these lessons descriptions of imaginary journeys are always much liked by the children.

(To be continued.)

—o—

Science Notes.

IT appears from an American paper that a new cement for glass, porcelain, and metals can be easily made by anyone possessing a few chemical appliances. The cement is really an amalgam of copper and mercury. Copper dust is first obtained by putting a piece of zinc into a solution of copper sulphate. This finely divided copper is heated with strong sulphuric acid. Mercury is added in small quantities, and the whole well stirred until the mercury and copper are in the proportion of two to one. The whole is then washed so as to remove all the acid, and afterwards set aside to cool. When it is to be used, it is first heated and then worked in a mortar till it is of the consistency of wax. It will in that state adhere tenaciously to any surface to which it may be applied. One great advantage which it possesses is that it can be used in the case of bodies which will not stand a high temperature.

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IT may not be commonly known that electric bells of a portable kind can be purchased at no great cost. In the case of sickness it is often of the greatest importance that an invalid should be able to communicate with some one in another part of the house. This is now happily quite possible. A small wooden box, not quite so big as a brick, contains an electric bell and the cell for generating the current. Two wires twisted together are attached by one end to the box and by the other to a piece of wood about the size of a watch. By pressing down a button in the small piece of wood the electric bell is made to ring. The wire is thin and will easily pass under a door. The patient can therefore have one end of the wire under the pillow and the bell can be put in any other room in the house. There is no need of fixtures, and the cell will last a long time without re-charging. The cost is about a sovereign. Many of our readers would no doubt be able to fit one up for themselves. There is really very little difficulty in doing so. The cell, wire and bell can be bought separately; a considerable part of the expense may thus be saved.

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THE report of the examiners on the results of the examinations held by the Science and Art Department has just been issued. The examiners in mathematics have made a detailed criticism of the answers to the questions proposed, which will be useful to teachers and also to students who intend to take the subject next year. The answers to the questions in theoretical mechanics are dealt with still more in detail. The general estimate of the papers seems to have been satisfactory.

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THERE is a remark in regard to the Sound, Light and Heat, which deserves attention. The candidates often describe imaginary experiments which are beyond the range of actual practice, as though they could be actually carried out, and even as if they were of everyday occurrence. The cure for this unscientific use of the imagination is to encourage the pupils to experiment for themselves. They will thus learn how difficulties may often be overcome, and what is equally important, how to avoid wasting time and energy in attempting things beyond their powers.

***

THE examiners in physiology usually give an elaborate report, and have done so this year. The subject of physiology is no doubt a difficult one to teach, involving as it does some knowledge of chemistry and physics. The main contention of the examiners is that some of the teachers who give the instruction do not really understand the subject themselves. They may have read books on the subject, they may know these books, but the things referred to in them they have not seen and handled. If this contention is true, there is no escape from the conclusion to which the examiners come—that the time and energy of the pupils are wasted.

***

WE have drawn attention more than once to the time at which the examination in Botany is held. So long as the present arrangement lasts Botany must be taught just at a time when there are no specimens to be had, and the instruction must necessarily be unsatisfactory. The effect of actually seeing the phenomena under discussion is apparent in the answer to a question on the structure, mode of growth, and chemical composition of a starch grain. The examiners say that the candidates appeared for the most part to have actually seen starch grains under the microscope. And they must see many other things under the miscroscope before they could be said to have a fair acquaintance with plant life and growth.

Eleven candidates presented themselves for honours in Botany, five of whom were successful. These were subsequently examined in practical work. In microscopic work and ability to identify specimens the examiners were not perfectly satisfied with these candidates. They admit however that a better result could hardly have been expected for the first time. The field is indeed a wide one, and some of the candidates had no doubt spent much time and done much good work on branches of Botany, upon which they had no opportunity of displaying their knowledge. It would be well if some rough outline of what course the practical examination would take could be announced. The candidates would not work less, and what they did would be to better purpose.

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IT is pleasing to record in the opinion of the examiner in metallurgy there is a marked advance being made in the practical teaching of this subject throughout the country. The examiner in the principles of agriculture says the elementary papers of this year are the best he has ever examined, there being distinct evidence of good and thorough grounding in general principles. This is encouraging and deserves recognition. There is always a danger of our dwelling too much on the faults and too little on the merits of the work we criticise.

WE take this opportunity of calling attention to a special report by the Bureau of Education, Washington, on the educational exhibits and conventions of the 'World's Industrial and Cotton Centennial Exposition, New Orleans, 1884-5.' A copy of this report ought to be found in all the educational libraries of the country. Let us hope one has already reached the reading room of the South Kensington Museum. The report gives a full account of the exhibits, illustrations often being supplied. The proceedings are given in detail, and, what is of far more value to the English teachers, the papers read at the conventions are printed *in extenso*. As might have been expected, a great variety of topics, many of them of pressing and immediate concern, were discussed with much freshness and ability. Those who take our advice and spend a few hours over this report will be amply rewarded for their trouble. It is not always that the acts and thoughts of other nations are available for those who speak no language but their own; but here we have the opinions of a people eager to solve the problems that await us, expressed in our own native tongue. American education is a popular subject. Those who care to know what is being attempted in the States should not neglect this last contribution to the literature of the subject.

Query Column.

RULES.

1. Each correspondent is restricted to *one question*. We should be much obliged if correspondents, who send questions for solution, would give (if possible) the required answer, and the source from which the question is obtained.

2. No query can be answered unless accompanied by the real name and address of the sender, not necessarily for publication, but as a guarantee of good faith and for facility of reference.

3. ☞ **When a pseudonym is adopted it should be written at the end of the query, and the real name and address on a separate piece of paper.**

4. Correspondents are requested to write their queries *legibly*, and on one side of the paper only.

5. Replies will not be sent through the post.

6. Queries must reach the office *not later than the 12th of the month*, or they cannot be attended to in the following issue.

*** All communications for this column should be addressed—'*The Query Editor*,' *The Practical Teacher, Pilgrim Street, Ludgate Hill, London, E.C.*

General.

1. WELSH P. T.—Yes; an addition is made on account of the success you obtain. At present the Latin at the scholarship is anything but easy. It is probable it will be made less difficult. You had better go through *Smith's* 'Principia' if you can do so. You should also read some easy sentences such as you would find in Part II.

2. ENQUIRER.—You should state the year of the pupil-teachership. Generally we should say you could not do wrong in using the following books among others:—Canon *Daniel's* 'English Grammar,' *Stanford's* 'Intermediate Geography,' *Cox's* 'History of England and the English People' (published by Hughes), National Society's 'School Management,' *Dunstan's* 'Manual of Music,' *Mackay's* 'Elements of Euclid,' *C. Smith's* 'Algebra,' or *Hall's, Todhunter's* 'Mensuration,' and *Barnard Smith's* 'Arithmetic.'

3. A THIRD YEAR P. T.—Will you kindly say where the extract is to be found. We will then deal with it.

4. JOHN WM. S.—'English lessons for the English People,' by *Seeley* and *Abbott* is excellent, *Whately's* 'Rhetoric' and *Bain's* are both good. There are so many books on Logic that unless we know definitely what you want we cannot do better than recommend you *Jevons'* 'Logic.' If you want a larger work buy *Bain's*. *Bain's* 'Rhetoric and Composition' is to be re-issued shortly.

5. EXPLORATOR.—Your query resolves into a cubic equation. Do you desire the solution? If i^* were $x^4 + y^4$, it could be worked by quadratics.

6. SNHOY.—You will have seen already in almost every number of this journal books recommended for special parts of the examination. We shall be glad to give you any further help you may require. You cannot possibly take all the subjects, and our space is limited.

7. CÆSAR.—Yes, you will receive additional marks for drawing, so many for each subject, which goes to qualify for the complete diploma.

8. DESIDERATUM.—A verb is in the passive voice when the action expressed by the verb affects the subject of the sentence. Now it is only with transitive verbs that the action expressed by the verb does affect something else; hence it is only transitive verbs that admit of a really passive voice. Strikes is a transitive verb. John strikes the table is an instance of a transitive verb in the active voice. The table is struck by John is an instance of the same transitive verb in the passive voice.

9. JUNO.—The books on the subject published by the National Society are very good: try them. You have seen several others mentioned in the query column during the past year.

10. IXION.—Given the perimeter and the difference between the perpendicular and base of a right-angled triangle to construct it. ('Mechanics' Magazine,' 1832.)

Let a represent the perimeter of the triangle, and let b represent the difference between the perpendicular and the base.

Let x = Base of right-angled triangle;

Then, $x + b$ = Perpendicular ,, ,,

And, $\sqrt{x^2+(x+b)^2}$ = Hypotenuse ,, ,,

$$\therefore x + (x + b) + \sqrt{x^2 + (x + b)^2} = a$$

$$x + x + b + \sqrt{x^2 + x^2 + 2bx + b^2} = a$$

$$2x + b + \sqrt{2x^2 + 2bx + b^2} = a$$

$$\sqrt{2x^2 + 2bx + b^2} = a - b - 2x$$

$$2x^2 + 2bx + b^2 = (a - b - 2x)^2$$

$$= a^2 + b^2 + 4x^2 - 2ab - 4ax + 4bx$$

$$2x^2 - 4x^2 + 4ax + 2bx - 4bx - a^2 + b^2 - b^2 - 2ab$$

$$-2x^2 + 4ax - 2bx = a^2 - 2ab$$

$$x^2 - 2ax + bx = \frac{2ab - a^2}{2}$$

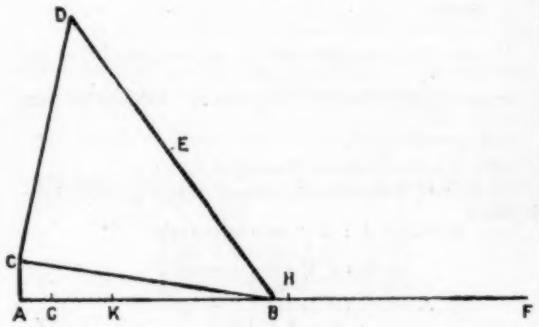
$$x^2 - (2a - b)x + \left(\frac{2a - b}{2}\right)^2 = \frac{2ab - a^2}{2} + \frac{4a^2 - 4ab + b^2}{4}$$

$$= \frac{4ab - 2a^2 + 4a^2 - 4ab + b^2}{4}$$

$$= \frac{2a^2 + b^2}{4}$$

$$x - \frac{2a - b}{2} = \pm\frac{\sqrt{2a^2 + b^2}}{2}$$

$$\therefore x = \frac{2a - b}{2} \pm \frac{\sqrt{2a^2 + b^2}}{2}.$$



Construction:—Let A B represent a, the perimeter.

Draw AC at right angles to AB, and let AC represent b, the difference between the perpendicular and base.

Join BC, and at C draw CD at right angles to BC, making CD equal to AB.

Join BD, and bisect it in E.

Then, BE represents $\frac{\sqrt{2a^2 + b^2}}{2}$.

$$BC^2 = AB^2 + AC^2$$
$$= a^2 + b^2,$$
$$BD^2 = BC^2 + CD^2$$
$$= a^2 + b^2 + a^2$$
$$= 2a^2 + b^2$$
$$\therefore BD = \sqrt{2a^2 + b^2}.$$

Produce AB to F, making BF equal to AB, and cut off AG equal to AC.

Bisect GF in H.

Then, HG represents $\frac{2a - b}{2}$

Make HK equal to BE.

Then, GK represents $\frac{2a - b}{2} - \frac{\sqrt{2a^2 + b^2}}{2}$

= Base of right-angled triangle,
And AK = GK + b
= Perpendicular;
$\therefore$ Triangle can be constructed.

11. H. J. WALKER.—As you kindly point out there was an error in the solution of No. 5 (Mensuration) in our last issue.

$$\text{Area of triangle CGD} = \frac{CG \times GD}{2}$$
$$= \frac{200 \times 400}{2}$$
$$= 40{,}000;$$

$\therefore$ Area of field = (188,000 + 25,312½ + 40,000 + 116,875) sq. links.

= 370,187½ sq. links
= 3·701875 acres

4

ro. 2·807500

40

po. 32·3000

= 3 ac. 2ro. $32\frac{3}{16}$ po. Ans.

Note.—You will notice that *your* answer is incorrect.

12. SUTTON-ON-HULL.—The equation to the circle is:—

$$x^2 + y^2 - 2ax - 2by + a^2 + b^2 - c^2 = 0;$$

Where x and y are the co-ordinates of a point on the circumference, a and b the co-ordinates of the centre, and c the radius of the circle.

Note.—Todhunter's 'Conic Sections' is a good text-book, but it is difficult. C. Smith's is more complete, and on the whole better.

13. ASSISTANT TEACHER.—Of all the dangerous advice that is offered to you be most on your guard of the medical advice of a layman. Beyond telling you that hoarseness may be the sign of a coming cold, or that it is a result of exhaustion in the vocal organs, we can do nothing better than refer you to a competent medical man. Rest, however, is an essential part of the treatment of all sorts of hoarseness.

14. WELSHMAN.—No. 1 is legible: that is a great merit. One might fairly say, however, that hardly any of the letters are of the recognised forms; it is rough and inelegant, 75. No. 2 is a specimen of copy-setting, and must be judged accordingly. The strokes are too thick and too upright; fully half the letters are incorrectly formed, 55. The large hand is bad. You don't hold your pen properly, or you would not leave the lines so jagged. The shapes of the letters are original and wrong. If you are in earnest about the matter try *Cowham's* 'Manual of Writing,' and his Copy Books. Practise every day for three months, and then send us another specimen, 50.

15. R. FISH.—Trace the changes of sign of cos A + sin A and of cos A − sin A as A changes from − 45° to 315°. (*Atkins.*)

(*a*) (1). Cos − 45° = cos 45°
Sin − 45° = − sin 45°

Cosine and sine of 45° are equal, but cosine of angles between 0° and 45° is greater than the sine.

$\therefore$ Between − 45° and 45° sign of cos A + sin A is +.

(2). Sign of cosine and sine of angles between 0° and 90° is +;

Sign of cosine of angles between 90° and 135° is −, but the sine is + and greater than the cosine; at 135° the cosine and sine are equal.

$\therefore$ Between 45° and 135° sign of cos A + sin A is +.

(3). Sign of cosine of angles between 135° and 180° is −; the sign of the sine is +, but it is less than the cosine.

Sign of cosine and sine between 180° and 225° is −.

$\therefore$ Between 135° and 225° sign of cos A + sin A is −.

(4). Sign of sine of angles between 225° and 315° is −; sign of cosine of angles between 225° and 270° is −, and between 270° and 315° it is +, but less than the sine.

$\therefore$ Between 225° and 315° sign of cos A + sin A is −.

(*b*) (1). Between − 45° and 45° sign of cos A − sin A is +.
(2). Between 45° and 135° sign of cos A − sin A is −.
(3). Between 135° and 225° sign of cos A − sin A is −.
(4). Between 225° and 315° sign of cos A − sin A is +.

16. BRUTUS.—The large hand is not good, 55. The small hand shows promise, and only needs practice to become a really good hand, 75.

17. J. H. T.—The best advice to a P. T. in his fourth year, who wants to prepare for the Matric. Exam., is contained in the articles on the subject in THE PRACTICAL TEACHER during the year 1884.

18. MUS.—Thanks for your solutions. They display great ingenuity.

19. MAINEY.—We think you could go in for model at the May Exam., and for some of the other subjects at the School Exam. You can learn all about the local examinations by reading the syllabus. This you can get from the local secretary or from the chief secretary. You will find the matter referred to in a former query.

20. H. M.—We learn that a key to *Abbott's* 'Via Latina' is now published, which can be had, upon the assurance that it will be properly used, by applying to the publisher.

21. SAM BROWN.—There is no mention of it in the code as a subject of examination. The prefixes and suffixes are really a part of the English grammar.

Arithmetic.

1. W.E.—A contractor employs a fixed number of men to complete a work. He may employ either of two kinds of workmen: the first at 26s. 6d. per week each, and the second at 18s. 6d. per week each; the work of one of the former being to that of one of the latter as 5 to 4. If he finishes it as quickly as possible, he spends £270 more than he would have done if he had finished it as cheaply as possible, but takes four weeks less time. What would it have cost if he had employed equal numbers of the two kinds of workmen?

(Brook-Smith.)

Time for both lots = 4 weeks × (5 + 4)
= 36 weeks;

∴ Time for first lot = $\frac{4}{5+4}$ of 36 weeks
= 16 weeks,
,, second ,, = 20 weeks;

∴ 26½s. × 16 × No. of men − 18½s. × 20 × No. of men
= £270,
424s. × No of men − 370s. × No. of men
= £270,
(424s. − 370s.) × No. of men = £270,
54s. × No. of men = 5400s.,
∴ No. of men = 5400 ÷ 54
= 100.

Part done in a week by equal numbers of the two kinds of workmen:

$= (\frac{1}{15} + \frac{1}{18}) \times \frac{1}{2}$
$= \frac{5+4}{80} \times \frac{1}{4}$
$= \frac{1}{160}$,

∴ Time to complete the work = $\frac{160}{1}$ weeks;

∴ Cost = (26s. 6d. + 18s. 6d.) × 50 × $\frac{160}{1}$

$= \left(\frac{5}{45} \times \frac{50}{1} \times \frac{160}{9}\right)$£

= £2,000. Ans.

2. DERA.—A farmer has a cow which at 3 years of age has a female calf, and afterwards a female calf every year. Each of the calves begins to breed in like manner at 3 years of age. How many head of cattle has the farmer when the first cow is 21 years of age?

No. of cattle at end of 3 years = 2,
,, ,, 4 ,, = 3,
,, ,, 5 ,, = 4,
,, ,, 6 ,, = 4 + 2 = 6,
,, ,, 7 ,, = 6 + 3 = 9,
,, ,, 8 ,, = 9 + 4 = 13,
,, ,, 9 ,, = 13 + 6 = 19,
,, ,, 10 ,, = 19 + 9 = 28,
,, ,, 11 ,, = 28 + 13 = 41,
,, ,, 12 ,, = 41 + 19 = 60,
,, ,, 13 ,, = 60 + 28 = 88,
,, ,, 14 ,, = 88 + 41 = 129,
,, ,, 15 ,, = 129 + 60 = 189,
,, ,, 16 ,, = 189 + 88 = 277,
,, ,, 17 ,, = 277 + 129 = 406,
,, ,, 18 ,, = 406 + 189 = 595,
,, ,, 19 ,, = 595 + 277 = 872,
,, ,, 20 ,, = 872 + 406 = 1278,
,, ,, 21 ,, = 1278 + 595 = 1873.

3. SEMI.—A man started a business. In four years he had trebled the capital he started with; at the end of three more years he had twice the sum of the original capital and the amount he had at the end of the fourth year; in his next outlay he loses a third of a half of what he now has, by a fire he lost 45 per cent. of the remainder, and received from insurance a sum equal to $\frac{9}{10}$ of his original capital. He then had £1150 16s. Find the amount he started with.

Supposing he started with £100;
Capital in 4 years = £300;
,, 7 ,, = 2(£100 + £300)
= £800;
Capital after next outlay = ⅔ of £800
= £$\frac{2000}{3}$;

Capital after fire = $\left(\frac{55}{100} \text{ of } \frac{2000}{3}\right)$£ + $\frac{9}{10}$ of £100
= $\frac{1100}{3}$£ + £90
= $\frac{1370}{3}$£;

£ £ £
∴ $\frac{1370}{3}$: 1150⅔ :: 100 : Original capital.

Original capital = $\left(\frac{42}{\frac{3754}{3}} \times \frac{2}{\frac{1100}{1}} \times \frac{3}{1370}\right)$£

= £252. Ans.

Algebra.

1. ENTERPRISING.—Two trains, A and B, leave P for Q at same time as two other trains, C and D, leave Q for P.

A passes C at 120 miles from P, and also passes D at 140 miles from P.

B passes C 126 miles from P, and passes D half-way between P and Q.

Find distance P to Q.

Let x = distance between P and Q in miles;

Let A, B, C, D represent the rates of the four trains per hour in miles;

Then, (1) A : C :: 120 : x − 120
(2) A : D :: 140 : x − 140
(3) B : C :: 126 : x − 126
(4) B = D

∴ (2) A : B :: 140 : x − 140
∴ B = $\frac{x-140}{140}$ A.

(1) A : C :: 120 : x − 120
∴ C = $\frac{x-120}{120}$ A.

(3) B : C :: 126 : x − 126

$\frac{x-140}{140}$ A : $\frac{x-120}{120}$ A :: 126 : x − 126

$\frac{(x-126)(x-140)}{140} = \frac{21}{126}\frac{(x-120)}{120}$

$x^2 - 266x + 17640 = 147x - 17640$
$x^2 - 266x - 147x = -17640 - 17640$
$x^2 - 413x = -35280$

$x^2 - 413x + \left(\frac{413}{2}\right)^2 = \frac{170579}{4} - 35280$
$= \frac{170759 - 141120}{4}$
$= \frac{29459}{4}$

$x - \frac{413}{2} = \frac{171{\cdot}63\ldots}{2}$

$\therefore x = \frac{413 + 171{\cdot}63\ldots}{2}$
$= 292{\cdot}31\ldots$

∴ Distance = 292·31…miles.

2. SUBSCRIBER.—Find two numbers such that the sum of their Arithmetical, Geometrical, and Harmonical means is $9\frac{1}{5}$, and the product of these means is 27. (*Todhunter's* 'Algebra for Beginners.')

Let a and b be the two numbers, and let A be their arithmetical mean, G their geometrical mean, and H their harmonical mean.

Then, (1) $A - a = b - A$

$2A = a + b$

$\therefore A = \frac{1}{2}(a + b)$.

(2) $a : G :: G : b$

$G^2 = ab$

$\therefore G = \sqrt{ab}$.

(3) $a : b :: a - H : H - b$

$a(H - b) = b(a - H)$

$aH - ab = ab - bH$

$(a + b)H = 2ab$

$$\therefore H = \frac{2ab}{a + b}.$$

$$A \times H = \tfrac{1}{2}(a + b) \times \frac{2ab}{a + b}$$

$= ab$

$= G^2$;

$\therefore G^2 \times G = A \times H \times G$

$G^3 = 27$,

$\therefore G = 3$.

$A + H + G = 9\frac{1}{5}$

$$\tfrac{1}{2}(a + b) + \frac{2ab}{a + b} + \sqrt{ab} = 9\tfrac{1}{5}$$

$$\tfrac{1}{2}(a + b) + \frac{18}{a + b} + 3 = 9\tfrac{1}{5}$$

$$\tfrac{1}{2}(a + b) + \frac{18}{a + b} = 6\tfrac{1}{5}$$

$(a + b)^2 + 36 = \frac{6}{5}(a + b)$

$(a + b)^2 - \frac{6}{5}(a + b) = -36$

$(a + b)^2 - \frac{6}{5}(a + b) + (\frac{3}{5})^2 = 1\frac{1}{25}\frac{6}{5} - 36$

$$= \frac{1156 - 900}{25}$$

$= \frac{256}{25}$

$(a + b) - \frac{3}{5} = \frac{16}{5}$

$\therefore a + b = \frac{16}{5} + \frac{3}{5}$

$= 10$.

(1) $a + b = 10$

(2) $ab = 9$

(1) $a^2 + 2ab + b^2 = 100$

(2) $4ab = 36$

$a^2 - 2ab + b^2 = 64$

$a - b = 8$

$a + b = 10$

$2a = 18$

$\therefore a = 9$ and $b = 1$

$\therefore$ Nos. are 1 and 9.

3. FOLKESTONIAN.—Obtain the r^{th} term of the series

$$\frac{x + 3y}{2}, \quad \frac{3x + y}{2}, \text{ \&c.}$$

Difference (Arithmetical Progression)

$$= \frac{3x + y}{2} - \frac{x + 3y}{2}$$

$$= \frac{2x - 2y}{2}$$

$= x - y$;

$$\therefore R^{th} \text{ term} = \frac{x + 3y}{2} + (r - 1)(x - y)$$

$$= \frac{x + 3y}{2} + r(x - y) - (x - y)$$

$$= \frac{x + 3y - 2x + 2y}{2} + r(x - y)$$

$$= \frac{5y - x}{2} + r(x - y).$$

4. BREF.—If $(x+1)^2 = x$, find the value of $11x^3+8x^2+8x-2$. (*Civil Service Examination.*)

$(x + 1)^2 = x$

$x^2 + 2x + 1 = x$

$\therefore x^2 + x + 1 = 0$.

$11x^3 + 8x^2 + 8x - 2$

$= 11x^3 + 11x^2 + 11x - 3x^2 - 3x - 3 + 1$

$= 11x(x^2 + x + 1) - 3(x^2 + x + 1) + 1$

$= (11x \times 0) - (3 \times 0) + 1$

$= \underline{1}$. Ans.

5. SUBSCRIBER.—Find how many words, each containing two consonants and a vowel, can be formed from 20 consonants and 5 vowels, the vowel being the middle letter of the word. (*Todhunter's* 'Algebra for Beginners.')

No. of *permutations* of 20 consonants 2 at a time

$= 20.19$

$= 380$;

$\therefore$ No. of words $= 380 \times 5$

$= \underline{1,900}$. Ans.

6. JURISCONSULTUS.—There is a certain number of two digits which is seven times the sum of the digits. The first digit is double the value of the second, and, if their difference be subtracted from their sum, the original number is ten and a half times the result. Find the number. (*Gibson's* 'London Matriculation Course.')

Let x = Digit in first or tens' place,

and ,, y = ,, second or units' place.

Then, $10x + y$ = number;

$\therefore$ (1) $x = 2y$

(2) $10x + y = 10\frac{1}{2}\left\{(x + y) - (x - y)\right\}$

(2) $10x + y = 10\frac{1}{2}(x + y - x + y)$

$= 10\frac{1}{2} \times 2y$

$= 21y$

$10x = 21y - y$

$= 20y$

$\therefore \underline{x = 2y}$.

This result is the same as (1), and therefore *any* number which has the tens' digit double of the units' digit satisfies the conditions.

$\therefore$ No. = 21, or 42, or 63, or 84.

Note.—The question is incomplete.

Mensuration.

1. H. E. J.—A wall, five times as high as it is broad, and eight times as long as it is high, contains 18,225 cub. ft. Find the breadth of the wall. (*Barnard Smith.*)

Breadth in ft. × 5 times breadth in ft.

× 8 (5 times breadth in ft.) = 18,225 cub. ft.

Breadth in ft. × 5 times breadth in ft.

× 40 times breadth in ft. = 18,225 cub. ft.

200 times breadth^3 = 18,225 cub. ft.

$$\text{Breadth}^3 = \frac{18225}{200} \text{ cub. ft.}$$

$= 91\frac{1}{8}$ cub. ft

$$\therefore \text{Breadth} = \sqrt[3]{\frac{729}{8}} \text{ cub. ft.}$$

$= \frac{9}{2}$ ft.

$= \underline{4\frac{1}{2} \text{ ft.}}$ Ans.

2. SALOPIAN.—A triangular space whose sides are in the ratio, 5 : 5 : 6 contains 588 square yards; find the length of its sides. (*Scholarship*, 1881.)

Let a represent the common factor of the sides in yards;

Then $5a$, $5a$, and $6a$ represent the sides in yards;

Perpendicular $= \sqrt{(5a)^2 - (3a)^2}$

$= \sqrt{25a^2 - 9a^2}$

$= \sqrt{16a^2}$

$= 4a$;

$\therefore$ Area of triangle $= 3a \times 4a$

$= 12a^2$;

$\therefore 12a^2 = 588$ sq. yds.

$a^2 = 49$ sq. yds.

$\therefore a = 7$ yds.

Wherefore sides $5a$, $5a$, and $6a$

$= \underline{35 \text{ yds., } 35 \text{ yds., and } 42 \text{ yds.}}$ Ans.

3. CECIL.—The spire of a church is a right pyramid on a regular hexagonal base; each side of the base is 10 ft., and the height is 50 ft.; there is a hollow part which is also a right pyramid on a regular hexagonal base, the height of the hollow part is 45 ft., and each side of the base is 9 ft.; find the number of cubic feet of stone in the spire. (*Todhunter.*)

Area of equilateral triangle
$$= \text{Side}^2 \times \cdot 43301\ldots;$$
$\therefore$ Quantity of stone in the spire

$$= \left\{ \frac{10^2 \times \cdot 43301 \times 6 \times 50}{3} - \frac{9^2 \times \cdot 43301 \times 6 \times 45}{3} \right\} \text{ cub. ft.}$$

$$= \left\{ (\cdot 43301 \times 10{,}000) - (\cdot 43301 \times 7{,}290) \right\} \text{ cub. ft.}$$

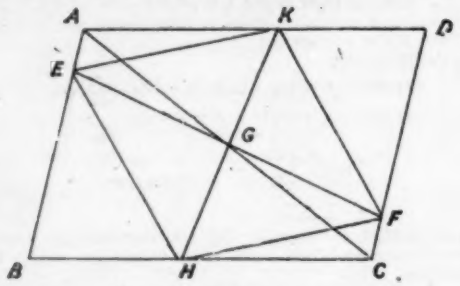
$$= \left\{ \cdot 43301 \times (10{,}000 - 7{,}290) \right\} \text{ cub. ft.}$$

$$= (\cdot 43301 \times 2{,}710) \text{ cub. ft.}$$

$$= \underline{1{,}173 \cdot 4571} \text{ cub. ft. Ans.}$$

Geometry.

1. CLAONA.—Inscribe a rhombus within a given parallelogram, so that one of the angular points of the rhombus may be at a given point in a side of the parallelogram. (*Todhunter.*)



Let ABCD be the given parallelogram, and E the given point in the side AB.

On CD take CF equal to AE.

Join AC, EF intersecting at G.

Through G draw HK at right angles to EF, cutting BC in H and AD in K.

Join E, H, F, K.

Then EHFK shall be the required rhombus.

Proof.—In the triangles AGE, CGE,
$\angle AGE = \angle CGE$, (I. 15.)
$\angle EAG = \angle FCG$, (I. 29.)
and side AE = side CF, (Con.)
$\therefore$ EG = FG,
and AG = CG.

Again, in the triangles EGK, FGK,
side EG = side FG,
side GK is common,
and $\angle EGK = \angle FGK$, (Ax. 11.)
$\therefore$ Base EK = Base FK. (I. 4.)

In the triangles AGK, CGH,
$\angle AGK = \angle CGH$, (I. 15.)
$\angle AKG = \angle CHG$, (I. 29.)
and side AG = side CG,
$\therefore$ GK = GH. (I. 26.)

Again, in the triangles EGK, EGH,
side GK = side GH,
side EG is common,
and $\angle EGK = \angle EGH$, (Ax. 11.)
$\therefore$ EK = EH. (I. 4.)

In the same manner it may be shown that FH is equal to EH, and also equal to FK.

Hence EHFK is a rhombus.

Note.—The construction fails if the perpendicular through G meets DC and AB, instead of AD and BC.

—o—

Publications Received.

Anderson, R., and Co.—

The Moloch of Paraffin. By Charles Marvin.

Bell, G., & Sons—

Leopold Von Ranke's History of the Latin and Teutonic Nations, from 1494 to 1514. Translated by Philip A. Ashworth.

Cassell and Co., Limited—

Cassell's Latin-English Dictionary.

Heywood, John—

John Heywood's Second Grade Perspective—Nos. 1, 2, 3, 4, and 5. By George Oscar Blacker.

Jarrold and Sons—

The Teachers' Diary and Pocket Book, 1887.

Longmans and Co.—

English Words Explained. By W. L. Davidson, M.A.

The Ghost of Brankinshaw. By Emily E. Reader.

Lady Brassey's Three Voyages in the Sunbeam.

Murby, T.—

Up the Airy Mountain—A Juvenile Fairy Cantata. By Thomas Murby.

The Arithmetic of Electrical Measurements. By W. R. P. Hobbs.

Murray, John—

Primary History of Britain. By Dr. Wm. Smith.

National Society's Depository—

Goldhanger Woods. By M. C. Lee.

Philip, G., and Son—

A Class Book of Physical Geography. By W. Hughes, F.R.G.S., and J. Francon Williams, F.R.G.S.

The Queen's Jubilee Atlas of the British Empire.

Siegle, A.—

French Commercial Correspondence. By W. E. Bayles.

Skerry and Co.—

The Civil Service Competitor—Dec. 17.

Practical Papers on Composition and Essay Writing. By G. E. Skerry, F.R.S.L., and W. Cromb, M.A.

Practical Papers on Digesting Returns into Summaries. By G. E. Skerry, F.R.S.L., F.S.Sc.

Smith, Elder and Co.—

The Cornhill Magazine—December.

Swan Sonnenschein and Co.—

Syllabus of Elementary Geometrical Conics.

The Young Collector—Crustacea and Spiders. By F. A. A. Skuse.

Notes of a Lesson on Movements of the Air.

BY JOS. H. COWHAM, F.G.S.,

Lecturer on School Method: Westminster Training College.

IV.—TRADE WINDS.

INFORMATION ARRANGED IN TEACHING ORDER.

ILLUSTRATIONS AND TEACHING HINTS.

A. Revision of truths taught in the lesson on Land and Sea Breezes.

1. When two adjacent earth surfaces are unequally heated there is a movement of air from the cool towards the warmer surface.

2. If two barometers either on the earth's surface or at the same elevation in the air stand at different heights, there is always a wind set up from the region of high pressure towards that of low pressure.

Recall the case of the land and sea breezes. The children should state:

(*a*). The different condition of surface temperature existing between the land and water during the day and night respectively.

(*b*). The winds which result from this difference of temperature.

(*c*) Similarly allow the class to state the effect in air movement of a difference of air pressure.

B. The Permanent Winds, called also the Equatorial or Trade Winds.

1. The earth's surface viewed as a whole is unequally heated, the hottest regions being those nearest the equator.

1. Refer to the lesson on the Land and Sea Breezes, and show that similar conditions are repeated here, only on a much grander scale.

Fig. 1.

2. The belt of greatest heat, or Thermal Equator as it is called, moves northwards during the summer, and backwards towards the equator in winter.

It may be noticed here that this region of greatest heat never, in the open ocean, reaches the south of the equator.

2. Diagram showing belt of greatest heat, and the Trade Winds on the north and south of it.

3. The trade winds blow towards this region of greatest heat both on its northern and its southern side.

They further may be noticed never to cross this belt of greatest heat, hence we infer a close connection between the **Trade Winds** and the **Heat Belt.**

3. Again lead the children to see the similarity of air movement forming these Trade Winds to that forming the land and sea breezes. The movement is from the cold air towards the warmer and lighter air.

By showing the northern or southern displacements of the Trade Winds in harmony with the northern or southern movement of the heat belt as in Fig. 1, children may be led to draw the inference that the wind is affected by, if not dependent upon, the position of the zone of greatest heat.

Arrangement of air pressure which follows the unequal heat, and assists in the formation of these winds.

1. The barometer at A, 5000 ft. above the sea level, at the equator, registers a higher pressure of air than one B, at the same height, but 20 to 30 degrees north or south of the equator. Hence there is an upper current from A to B. This upper current is called the **Counter Trade Wind.**

2. By the flowing over of air in this upper current to B, the barometer on the surface at D rises, and soon stands higher than a barometer at C.

Hence there is a current set up on the surface from D to C. This surface current is the ordinary **Trade Wind.**

Fig. 2.

Diagram showing three supposed layers of air, 1, 2, and 3, differently heated, and swollen upwards at the equator.

By the diagram show [that at A there must be a greater weight of air than at B.] Hence movement from A to B takes place.

2. Refer again to the explanation of Land and Sea Breezes. The same holds in explanation of the Trade Winds.

Thus in the Trade Winds as in the Land and Sea Breezes, a difference of surface temperature sets up a difference of barometric pressure, and this is followed by the Trade Winds over the great oceans.

The map shows the position of the Trade Winds in the Atlantic Ocean. It also shows the northern and southern limits of these Trade Winds and the **Calm Belt** separating the northern from the southern Trade Wind.

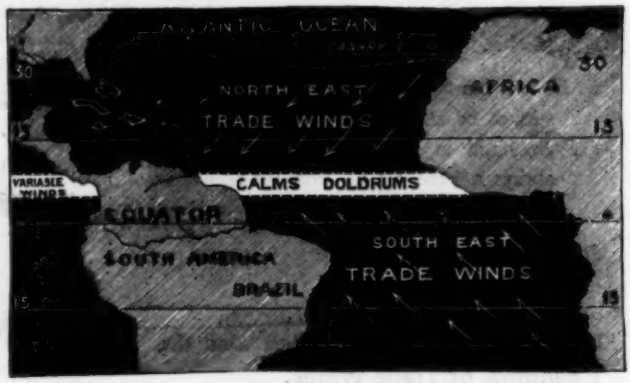


Fig. 3. Trade Winds over the Atlantic.*

The Direction of the Trade Winds is modified by the rotation of the earth on its axis.

1. If the earth did not rotate these winds would blow directly N. and directly S., *i.e.*, from the cold to the warm areas.
2. When any mass of air moves southwards in the northern hemisphere towards the equator, it passes into latitudes in which the rotatory movement increases with every mile of approach.
3. The air moves round with the earth, but in changing its latitude it cannot take up immediately the increasing rotatory movement of the earth.

Hence to anyone on the earth's surface, who travels round with it towards the east, there appears to be a wind not moving so fast eastwards as he does—a wind which appears to come from the east. **This wind is the North-East Trade Wind.** Similarly we may explain the south-east Trade Wind.

DEFINITION—

The Trade Winds are permanent air movements, which have a N.E. direction on the north of the equator, and S.E. on the south of the equator.

They are caused by the excessive heat of the land and the air near the equator.

Refer again to the Land and Sea Breezes. These winds blow directly from sea to land and from land to sea. So the Trade Winds blow towards the equator.

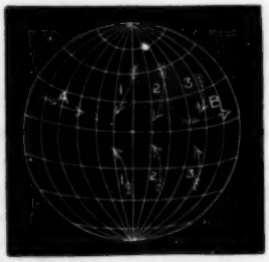


Fig. 4. Explaining the easterly twist of the Trade Winds.

2. Show the fact by rotating a globe. At the pole there is no movement, whilst at the equator the movement is about 1000 miles per hour.

3. Set a globe spinning, and with chalk in the hand try to draw a line along one of the meridians. In order to do this you must move the hand in the direction the globe is rotating just as fast as the globe moves. If your hand should move slower the mark will gradually appear to come from the east.

* For complete maps of the Trade Winds consult Keith Johnstone's Physical Atlas.

Publications Reviewed.

Up the Airy Mountain. A Juvenile Fairy Cantata. Music by Thomas Murby. London: T. Murby.

We fail to see why this composition should be called a Cantata; though, perhaps, a composer is at liberty to select any name he thinks best for his work. The melodies are bright and tuneful, and fairly original, while the harmony, though conventional in style rather than grammatically strict, is varied and effective. On the whole, we can commend this composition to our readers as a welcome contribution to the somewhat scanty store of part-music for children.

Text Book of Musical Elements. By G. Oakey, Mus. Bac. Curwen and Sons, London.

This is an excellent little text-book, containing a large amount of interesting and well-arranged matter, with a valuable collection of Questions and Exercises. Mr. Oakey has had considerable experience in teaching, and is, therefore, able to anticipate the beginner's difficulties, and to make prominent all those points which need special attention.

The general 'get up' of the book is all that could be desired, and the language and style are, as a rule, forcible and clear. There are, however, occasional grammatical constructions which are needlessly involved and ambiguous, as the following, for example, on the first page:—

PITCH is the term used to express the difference between musical sounds that result from the variation of the number of vibrations of the air in a given time.' A verbal revision of the text would make Mr. Oakey's book all that could be desired.

The Royal Songster. Nos. 1 to 6. London: Curwen and Sons.

This is a most admirable collection of two-part school songs. The books, which are published at a penny each, are attractive in style and appearance, and are graded to suit the different divisions of the Code. We are sure that the majority of the songs will at once become favourites in any school where the Royal Songster is introduced. Each number comprises thirty-two pages of music, and contains from thirty to forty pieces.

The Child Pianist. By Mrs. J. S. Curwen. London: Curwen and Sons.

This is, doubtless, one of the best introductions to the study of the Piano which has yet appeared. Mrs. Curwen tells us that the lessons of the 'Child Pianist' are the result of an attempt to systematize, for the use of her own children, the plans which she has used in former days in teaching the Pianoforte, and she now offers them to teachers, hoping that they too may find them useful. The chief aims of the book are to combine 'Theory and Practice,' and to teach 'One thing at a time;' and we are quite sure that the result is a splendid success. Mr. John Kinross, who has written the musical exercises and illustrations, has composed a large number of clever and interesting duets, in which the child *from the very first stage* can take part, and feel that, instead of a dry, technical, and perhaps dull practice, he is helping to perform a real musical composition.

We heartily wish the 'Child Pianist' every success.

Pupil-Teacher's Notes for the Government Syllabus. By W. H. Stanton. London: Curwen and Sons.

Used in connection with a good text-book these notes will doubtless prove very useful. They are well-arranged and clearly illustrated. Sets of questions are appended to each year's 'Notes' and add considerably to the value of the book.

The Technical Drawing Books. Freehand. By G. Richards, Art Master. London: Simpkin, Marshall, and Co.

The designer of these books, nine in number, offers them as the first instalment of a series intended to assist teachers of public and elementary schools in giving a systematic training in drawing as an important element of technical instruction. The designs in the earlier numbers are of very great simplicity, and much help is given by means of points and parts of lines marking out the shape and dimensions of the figure to be copied. At the earliest possible stage it is sought to give interest to the practice of drawing by introducing simple outlines of familiar objects. The first book is confined to straight lines and simple combinations of them, the second to curved lines, separate and combined. Then follow books containing outlines of objects formed by straight lines, and others formed by curves. Books 5 and 6 introduce ornamental designs in which there is considerable variety and novelty. The help given by guiding lines, which, in the earlier numbers, might be thought excessive, is gradually withdrawn until in the more advanced books we find more complicated designs to be enlarged or reduced, with indications only of the size the copy is to be made. In this stage also we find careful graduation of the assistance afforded; thus in number 7 each design is drawn in a rectangle, whose dimensions are 5 by 3, and which is divided into 15 squares. By the side of each copy is placed a larger or smaller rectangle, similarly divided. In book 8 the divided rectangle appears in the copy, but only a divided axial line is given to assist the pupil, and in book 9, which contains some very graceful designs, the axial line only is given in the copy and the space for imitating it. Though not divided into standards according to the new drawing syllabus of the Education Code, these drawing books are so well graduated as to be thoroughly well adapted for preparing classes for the new examinations.

A School Bank Manual. By Agnes Lambert. Cassell and Co., Limited.

Matthew Arnold has just reminded us that Bishop Butler, in his sermon before the Mayor of London in 1748, laid it down that the poor were very much what the rich made them. Till every vice be unknown among the rich, the Bishop said, the manners of the poor will not be what they ought to be. Mr. Arnold thinks the poor will be largely what the teachers make them. Others believe it too. If so, the teacher's calling is serious indeed. The little manual before us calls attention to one important phase of national life, that of forethought and thrift. It is impossible to exaggerate the necessity for forethought and thrift. The lamentable neglect of both by the poor and especially the very poor, has brought them, in many cases, face to face with starvation. No socialistic or communistic nostrums can be of permanent avail unless the poor are taught to consider the consequences of spending all they earn and marrying before they are able to meet the expenses which are sure to follow.

We hope a copy of this manual will fall into the hands of every teacher, and that penny banks may be established all over the land.

Guide to Employment in the Civil Service. London: Cassell and Company, Limited.

When we find that a book, which appeals as this does to a limited class, reaches an issue of twenty eight thousand, we have in its popularity some guarantee that it is well adapted to its purpose. This purpose is set forth in the Introduction, written by Dr. J. D. Morell, and is to aid intending candidates in deciding as to the branch they will endeavour to enter, and as to the best means of preparing themselves for the required tests.

The first portion of the work is devoted to Preliminary Information in which the system on which the Civil Service is regulated is explained. Then follow the regulations as to Examinations, including the fees to be paid

by Candidates for different posts. Next comes a lengthy section giving full details on the Subjects of Examination and limits of age for the whole series of appointments. Another division extending over seventy pages gives details as to the situations in the various offices and the salaries attached to them. A series of specimen examination papers follows, and will give intending candidates a fair idea of the scope of the examinations. As these examinations are competitive, it may be as well for students to remember that success can only be expected by those who can do the work thoroughly in the subjects required. A list of books recommended for study of the different subjects is added; and the work concludes with appendices on the examinations for the Civil Service of India, and Post Office situations. The information is very full on all points, and is brought down to date.

Cassell's Modern School Series. Shakespeare's Plays for School and Home Use—Hamlet, Henry V., Richard III. Cassell and Company, Limited, London.

In continuation of a series begun some time ago the enterprising publishers have issued three more plays in an abridged form for the use of children in the upper standards of elementary schools. Each play is reduced by judicious omissions to about 1,500 lines. In addition to a short biography of the great dramatist each volume contains a concise introduction to the subject of the play, well-written in a spirited style. Brief notes are appended to explain the more difficult words and expressions, and to throw light upon historical and other allusions. The thin smooth cloth binding is well-adapted for books of this size and character.

Geography of England and Wales from Ten Different Standpoints. By T. M. Davidson, M.A. London: Laurie's Educational Depository.

A novel idea, thoughtfully planned and skilfully executed. The sketch maps are an excellent feature in this work. They are drawn by the teacher's own pen and only require that in some details they should be more exact, *e.g.*, the North Eastern Main line does not run through Stockton. The N. Downs should terminate in the North Foreland as well as South Foreland, and the South Downs should be made to run completely up to Beachy Head.

Elements of French Grammar and first Steps in Idioms. By Professor A. Barrère. London: Whittaker and Co.

This work, by the same author as the one noticed above, is intended we presume for pupils at the same stage, and probably to be used as a companion book. The lessons are thus arranged: At any given opening of the book we find the grammar to be learnt printed on the left hand page, two lessons occupying each page. Each lesson in grammar is accompanied by two exercises of the usual type for translation, French into English, and English into French, and these are printed invariably on the right hand page so that the exercises face the corresponding grammar lesson. The graduation of the course of instruction has been very carefully attended to. The simpler and more commonly used idioms are introduced as grammar lessons, and exemplified in the exercises, near the end of the book. Vocabularies arranged alphabetically are appended. On the whole the work seems to be very well adapted for its purpose.

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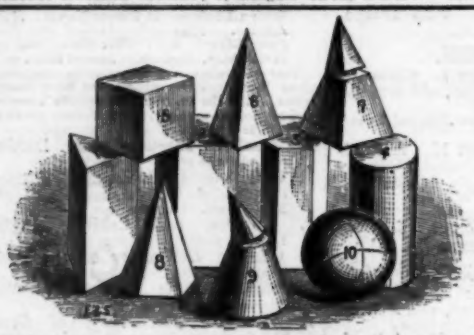

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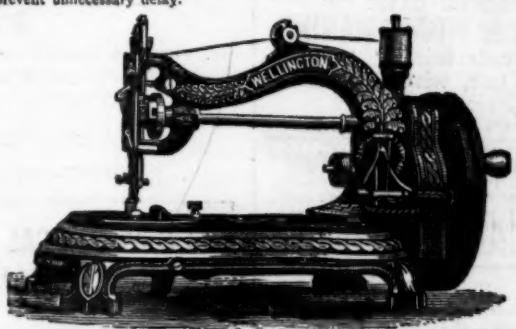

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